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Digital Computers for Television Automatic Switching Control

By A. B. ETTLINGER

The first application of a digital computer to television automatic switching control has been developed under CBS auspices and went into operation on December 31, 1960. The resulting system offers a considerable advance over previously-used techniques with respect to functional capacity, ease of revision of program schedule, and adaptability to changes in operating practice. In meeting these stringent requirements, the computer approach proves to be economically sound, offering features unattainable by other means except at prohibitive cost. The present paper describes the theoretical considerations relevant to this application.

Introduction

Of the various skills employed in the operation of television broadcasting facilities most will be found, upon analysis, inherently to consist of intelligent decisions based upon human perception. Some operations, however, while requiring a high order of manual dexterity, are inherently mechanical in nature. Station break switching in a local station falls largely into the latter category.

In general, station breaks consist of short sequences of recorded visual material and accompanying announcements of predetermined duration. Video and audio switching, combined with start-stop control of picture and sound playback equipment, requires a heavy concentration of attention for a brief interval that usually occurs no more frequently than two to four times an hour. Insofar as this activity can be mechanized, and it is economical to do so, the human energy now devoted to it may be considered wastefully employed. Conversely, the maintenance of a high standard of technical picture and sound quality within short sequences of recorded material is a problem which, in the present state of the art, can often benefit from a greater concentration of human effort. Therefore, if the energies currently applied to the mechanical task of switching can be diverted to the more important jobs of surveillance of signal characteristics and level control, superior on-air technical quality should certainly result.

A general recognition of the potentialities of automatic station break switching has been evident in the broadcasting industry for the past few years, as is indicated by a number of systems which have been proposed. There are two general types of systems, each designed for a specific objective. On the smaller scale is the limited-capacity system which aims at setting up only one station break sequence for each operating cycle. The more ambitious application provides for programming the station's operation for an entire day.

Single station break systems were the earliest devised. In perhaps the simplest form of such a system, the information is set up on mechanical switches.[1,2] Another development made use of mechanically-latching relays to store switching events.[3] One of the more recent station break systems has employed electronic storage with gas-filled character display tubes.[4]

To go beyond the single station break to full-day operation, the major information storage medium used to date has been punched paper tape.[5,6] While the storage density of paper tape is such that there is no practical limit to the event capacity of a tape system, certain sacrifices in system performance are made necessary by the relative inaccessibility of the data, as will be further detailed.

Presented on September 23, 1960, at the Symposium of the IRE Professional Group on Broadcasting by A. B. Ettlinger, Engineering Dept., CBS Television Network, 485 Madison Ave., New York 22. After slight revision, the paper is here reprinted by permission of E. K. Gannett, Managing Editor, The Institute of Radio Engineers, from *IRE Trans. on Broadcasting*, vol. BC-7, no. 2, pp. 29–36, Mar. 1961.

Basic Considerations

For an analysis of the various interrelated factors that need to be resolved for a closer approach to an ideal television automatic switching control system, the general problem can be considered as divided into four distinct parts, namely: the data storage system, the data entry system, the display, and the control system. These areas, and the criteria to be considered in their design, may be delineated as follows:

1. The Data Storage System

The data to be stored is divided into a number of switching events. An event is defined as the total information needed to specify one instance of change in program material. The basic item of information is the signal to be selected. If there is consistent correlation between simultaneous video and audio signals, only one signal selection need be specified. Alternately, for greater flexibility, the video and audio selections might be specified separately and independently. If video lap dissolves, audio fades, random-access slide projector operation, or other special functions are to be provided, these would also be part of the event. An additional essential element in the event is the information that specifies the time at which it is to occur. This may be expressed as the actual clock time, or the duration of the event itself. The minimum event duration of automatic broadcast switching systems is generally specified as one second. The capacity of the data storage system is measured by the amount of information per event multiplied by the number of events. The accessibility of the data is measured by the facility with which it can be read out, either for internal system purposes, or for display to the operator. The ease with which revision of data can be accomplished is also a very important consideration.

2. Data Entry System

Some means must be provided to enter data into the data storage system. The efficiency of data entry is highest when

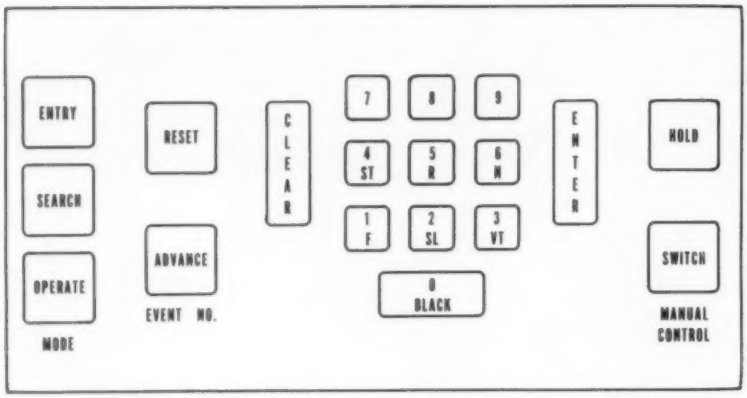

Fig. 1. A data entry panel for manual entry of television switching events by sequential key punching. The number of keys has been minimized for simplicity, without sacrifice of clarity.

the number of manual operations required to enter the data for a given block of programming is reduced to a minimum. For example, the event functions as dealt with above did not include the starting of playback equipment. Since each piece of playback equipment is started in its own logically consistent manner, there should be no necessity to enter separate items of information specifically for this purpose, since the provision of starting impulses can be an automatic internal system function.

While a fully developed system may employ automatic data entry, such as punched cards or a punched paper tape derived from the program schedule preparation process, nevertheless, a manual entry system is essential for convenient revision of data. Furthermore, manual entry alone may be adequate for a simple system, or one in which full-day scheduling is not initially attempted.

A hypothetical idealized data entry panel is shown in Fig. 1. The panel is built up around the standard ten-key adding machine keyboard, with the basic design objective of applying human engineering principles to achieve the maximum in operating ease and accuracy.

3. Display System

Some display of data as the system automatically sequences through events is essential to permit operator surveillance. An ideal display would show data as alphabetic and numeric characters, preferably using symbols readily identifiable by the operator, so as to avoid the introduction of special codes. The display also facilitates manual entry and search operations, and can vary in size depending upon the number of events to be displayed simultaneously. A typical display panel is illustrated in Fig. 2. This panel, which is similar in layout to those of previously designed equipment, could serve as a companion to the entry panel of Fig. 1.

4. The Control System

The control system interprets the stored event data into the switch contact closures required for operation of the external controlled equipment. Part of this interpretation is the use of the stored timing data to cause the switching impulses to occur at the proper time. This system may include some rather sophisticated functions, such as the scanning of several upcoming events to provide switching impulses for the advanced starting of film projectors and magnetic tape reproducers. The starting of playback equipment is relatively simple if the system can depend upon the machine to be started always appearing in the "next event" display register at the instant when the time remaining in the "on-air" event equals the anticipatory start time. In the circumstance, however, where the duration of the preceding event is less than the anticipatory start time, this system obviously breaks down. If there are to be no restrictions of the scheduling of short events, the control system must be capable of scanning several advance events and interpreting their contained timing data for proper actuation of machine starts in the worst possible case (such a case, hypothetically, might be seven one-second slides scheduled immediately prior to a video-tape reproducer having a seven-second start-up time). A block diagram illustrating the interrelationship of these system sections and the external controlled equipment is shown in Fig. 3.

Limitations of Current Technique

Upon reviewing the current types of systems in the light of this summary of the problem, it becomes apparent that each of the two existing general categories of systems satisfies certain criteria only at the expense of others. The limited capacity, single station break systems offer ready accessibility to data for revision. Since data is accessible, scanning of advance events for automatic prestarting of playback equipment is feasible. An approach that uses electrical or electronic circuit elements as units of memory, however, is of necessity severely restricted as to capacity by economic considerations. If a system is required for handling an extended sequence, such as the closing and opening of the programs adjacent to the station break, or if additional functions beyond signal selection are desired within each event (such as lap dissolves or other special effects) a more economical data storage medium becomes a necessity.

In a paper tape system, storage capacity in terms of number of events is not a problem. The number of functions per event is not inherently limited, although later expansion beyond the originally-provided capacity may be awkward unless provided for specifically. The subsidiary function of prestarting playback equipment, however, presents difficulties. The automatic scanning needed to permit full flexibility in the scheduling of short events presents an awkward problem in the design of a paper tape system. Therefore, if limitations on event duration are to be avoided, it is necessary to enter the prestart information as a separate switching event, which reduces the efficiency of data entry.

Accessibility of data for revision is also inhibited with the paper tape storage medium. The usual approach to the problem has been to provide a second tape reader with a transfer system which automatically introduces alternative sections of tape. While this may be a useful expedient, it falls somewhat short of the ideal, namely, the capability for introducing a revision at any time to any part of the schedule, without limitation as to the number of revisions or the sequence in which they are received for insertion.

There is, of course, the possibility of a combination system, in which a limited capacity station break system with a cycling memory could be fed from a paper tape. Such a system would provide a sufficient measure of accessibility to data to solve the prestart problem, but would still be far from the ideal from the standpoint of program schedule revision.

In seeking a closer approach to the ideal system, the objective goes beyond a mere efficiency improvement from the time-and-motion standpoint. Human errors in the operation of a complex automatic control system are often more disastrous than with a manual control system, since they are generally not detected immediately, and, when detected, often cannot be quickly or easily corrected. An optimum man-machine relationship, therefore, means not only a minimization of the number of manual operations, but also an arrangement of operations in the most logical pattern

possible. If awkward expedients are necessary as compensation for an inherent lack of flexibility in the basic approach, the resulting system becomes undesirably prone to human error. A design concept based upon the free use of all applicable human engineering principles yields its greatest reward in the reduced likelihood of operating errors, and consequently greater acceptance by operating personnel.

The Computer Approach

In seeking a new approach to the automation problem that avoids the limitations inherent in current systems, it became apparent that the key element is a random-access memory system of adequate size. The single station break systems currently in use, with their small random-access memories, can satisfy all requirements except for capacity, which is limited by economic considerations. A bulk data storage system which is economically within bounds would offer the possibility of developing a near-ideal television automatic switching system.

In digital computers, random-access memories are a major system component. The electronic computer field is relatively young and still changing rapidly, but the first generation of designs can nevertheless be considered as well-established and of proven capabilities. To assess the potentialities and economics of a digital computer as the data storage and control component of a television automatic switching system, the characteristics of the smallest general-purpose digital computers that are marketed as standard products were considered. Such machines are known as "desk-size" in that they are normally packaged in a desk-size console or a single equipment rack, and are priced in the region of $50,000. For illustration purposes, a computer design will be described which, while by no means universal, is typical of the class.

The simplest computers, which are qualitatively little different from the largest, use a magnetic drum memory. The drum is a cylinder of nonferrous metal, coated with an iron oxide or nickel-cobalt film, that is rotated, typically, at a speed of 3600 rpm. Surrounding the drum is a frame containing many magnetic recording and playback heads, separated from the surface of the drum by a small air gap. The heads are arranged to record parallel tracks, numbering about 64 in a typical small drum. Data is recorded on the drum, as it is processed by the computer, in binary form. The element of data is the "bit" which represents a choice between either of two states ("on" vs. "off," or "0" vs. "1"). The organization of data is always in "words" which consist generally of about 32 bits each in the typical general-purpose computer. The location of a word on a given track is specified as its

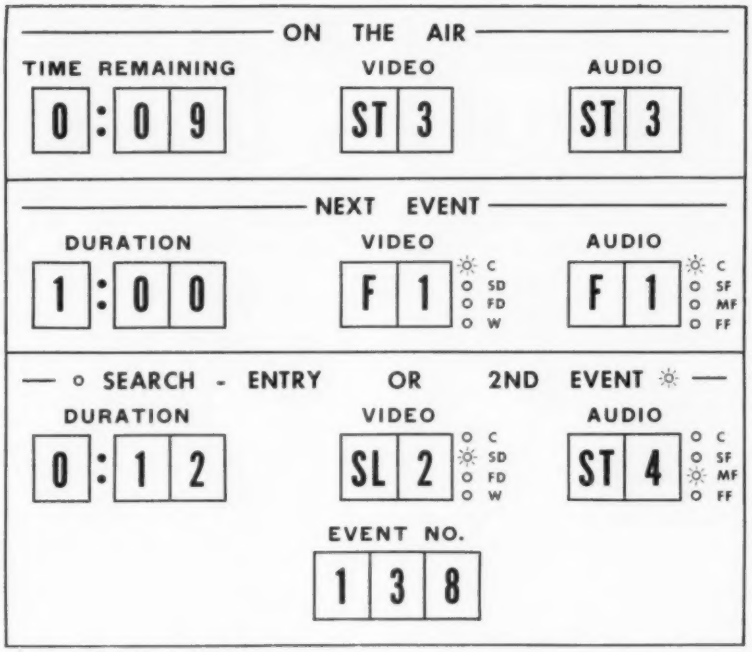

Fig. 2. An automatic television switching system display panel. "On the Air" and "Next Event" information are displayed, plus a utility event display that can either search out any stored event, or show the second upcoming event. Event timing is illustrated on a duration basis. Auxiliary functions for specifying the type of video and audio transitions are included.

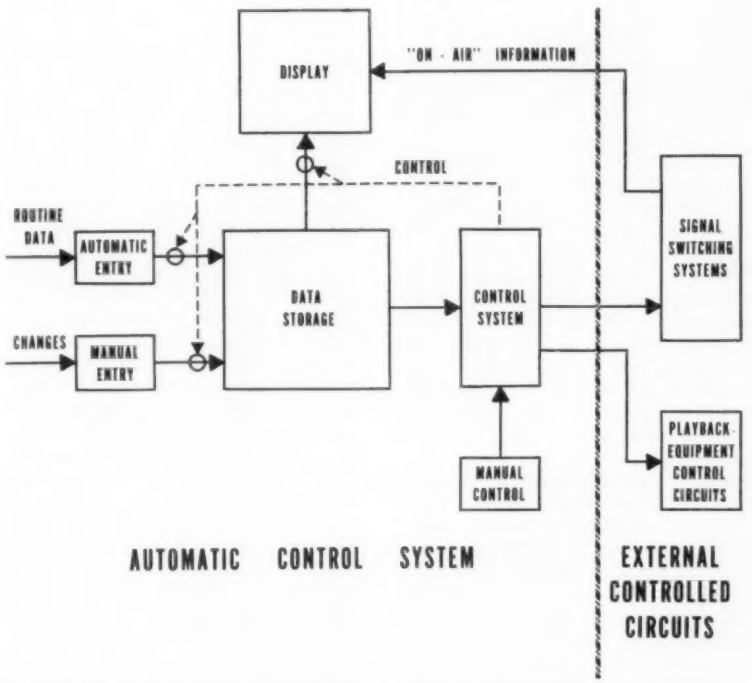

Fig. 3. Block diagram of the general television automatic switching system. The four basic elements of storage, entry, display and control are required to automatically operate station switching and playback equipment. The control system supervises the communication among all other elements.

"sector." The typical small drum under consideration might have 64 sectors per track, or a total drum capacity of 4096 words (or 131,072 bits).

Relating this capacity to the data storage requirement for a full-day television schedule, a switching event utilizing one 32-bit computer word could contain enough information to specify a complete actual clock time to one-second accuracy, a choice of one out of 32 different video sources and an independent choice from the same number of audio sources, plus two additional four-choice functions, such as the specification of the type of video transition between cut, slow or fast dissolve, or wipe, and an audio transition choice between cut and three rates of fade. Two computer words would certainly suffice for a complex switching event including several auxiliary functions. Two thousand events is thus not an unreasonable estimate of the number of switching events that could be stored on the full capacity of a typical small computer drum.

A rough estimate of the number of events in a maximum day's operation might be indicated by assuming fifty station breaks per day, with few of them involving more than ten events. A typical computer drum thus appears to be large enough for the application by an order of magnitude. In actual practice, not all of the drum would be available for event storage, since a portion of it would be employed as part of the control system. Nevertheless, the size of such a storage relative to the need is very likely such as to permit a reasonable amount of extravagance in the event format, including probably even full duplication of all stored data for the insurance of very high reliability.

Having established the adequacy of data storage capacity, the integration of a computer into a complete automation system is next to be considered. The data entry system would not actually require anything other than a standard computer accessory — a paper tape reader. To take full advantage of data accessibility, however, as has been discussed, some sort of manual means such as the keyboard of Fig. 1 is desirable to control the searching out and entry for revision of at least small blocks of data.

The display system would be the major item required in addition to the computer itself for a complete automation system. The typical computer puts out data relatively slowly, usually into an electric typewriter or other type of printer. When high-speed output is needed, magnetic-tape recording is generally employed. The operation of a number of switching relays and a display consisting of many in-line readouts, such as would be desired from a television automatic switching system, requires essentially that the computer operate a large number of relays at a higher speed than normally necessary for operation of printers or other electromechanical data output devices. This is not a task for which the standard general-purpose scientific or business computer is normally designed. Applications of computers for plant operating control in the process industries, such as for oil refineries and chemical plants, however, require the solution of this type of problem. The techniques for digital output which have been developed for process control require only a nominal amount of modification to a standard computer.

With reference to the control system, two general approaches can be adopted to accomplish the necessary automatic analysis of data required to produce the proper output switching impulses. The desired operation could be performed by special circuitry designed expressly for the purpose, and substituted for the computer's general-purpose circuitry. Such a device would in effect no longer be a computer, but a special-purpose digital system. Alternatively, the system can be kept general in nature, taking advantage of the versatility of the original general-purpose computer design. Discussion of the latter possibility requires first a consideration of the manner in which a computer operates.

Computer Internal Operation

The words that are written on the computer drum can be either of two types. Data is assembled into words in whatever format happens to be convenient to the specific problem. Some of the words on the drum, however, will be arranged in a fixed format as "instructions." These words control all activity within the computer. In general, any word location in the working part of the drum can be either an item of data or an instruction. It will be recalled that any word on the drum can be identified by its track and sector, also called its "address." If there are 64 tracks and 64 sectors, each can be identified by a binary number of six bits, so that twelve bits will serve to specify the address of any one of the 4096 words on the drum. Pushing the "start" button on a computer generally causes it to "look" at one specific word address. The word at that address will be an instruction. Twelve of the 32 bits in that instruction word will be the address of some other word anywhere on the drum. Part of the remainder of the instruction word, a block of perhaps six bits, will be the "command" that tells what is to be done with the word specified in the address portion of the instruction. The command repertoire of a computer can range in number from as low as 16 up to several hundred. After executing the command, the computer automatically follows a sequence of looking at successive addresses and executing the instruction it finds.

Instructions are generally executed in one or more "registers," to and from which data can be transferred, and within which arithmetic operations can be performed. Such registers may hold one or two words. Typical instructions would be "Bring the word at address X to register A" or "Place the word in register A at address X" or "Add (or subtract) the contents of address X to the contents of register A" or "Clear register A to zero." The last command, it will be noted, simply concerns register A, as typical of some commands, and requires no address. The sequence of instructions written for recording onto the drum is called a "program." This term, widely used in the computer field, easily causes confusion when it enters the broadcast industry. "Programming" a computer for television broadcast switching means writing the instructions that determine its mode of operation. The broadcast "program" schedule that is placed into the computer is properly termed "data," from the computer's standpoint.

The great versatility of a computer is derived from a certain type of instruction called a "conditional transfer." While there is a standard sequence of addresses that is normally followed, a "transfer" instruction causes the computer to go to any desired address for its following instruction, subsequent to which it will follow the standard sequence from that address. In the conditional transfer, a test is performed, such as whether the number in a register is positive, negative, or zero, and depending on the result, either to continue on to the next normal instruction or to jump to a completely different series of instructions. This powerful tool is the essential decision-making technique within a computer, and permits the construction of very complex organized processes which can be executed by a relatively small amount of actual circuitry.

It is entirely feasible in using a computer in a control system to generalize the actual circuitry, providing whatever numbur of output relays are needed to execute the total number of functional choices for which the system is designed, and then control the operation of the relays completely by a program.

The question will arise as to whether a typical small-scale computer operates fast enough for the purpose. The maximum hypothetical demand on the system can be substantial, if several successive one-second events are to be accommodated. Within each one-second interval, several events may have to be examined for prestarts. The execution of an instruction dealing with an address located randomly about the drum might take as long as one drum revolution or 1/60 sec, and each event scanned requires a few instructions. The writing of an adequate program for the application

is not necessarily a routine task, but indications are that a number of tricks of the programming art can be applied to reach a satisfactory solution, even on such a relatively slow computer as has been described.

One appreciable advantage of the use of a programmed generalized system is the ease with which modifications can be made should it be desired to change operating practices. The installation of a program modification can be as simple as the entry of the basic data fed into the computer. Modifications may, however, if extensive, involve in the writing the cost of the services of a professional programmer. Nevertheless, much more flexibility would certainly be available at lower cost than if the equivalent were achieved by physical modification. Perhaps more importantly, program modification does not require shutdown of the system. Thus the use of a general-purpose computer rather than a special-purpose device seems logical.

Reliability

One factor the broadcaster will naturally question is the basic reliability of a computer system. Inasmuch as any single error can likely result in direct monetary loss, the broadcasting application imposes a different sort of reliability demand than does the usual computer application, where, in general, errors need merely be detected as such, usually followed by an automatic stoppage of the computer. Transient errors can occur occasionally in a computer system where a stray pulse changes a bit from "0" to "1," or vice-versa. Fortunately, however, a ready technique is available to detect such errors, with what is known as a "parity check." This technique employs a count of the number of "1"s in a word, and inserts an extra bit as required so that the number is always either even or odd. Every operation is then checked for parity (an even or odd count of "1"s) so that single bit errors are immediately recognized. The program can be written so that an alternative course of action then follows — either to "try again" or to transfer to a duplicate set of data. Double errors are not guarded against, but the probability of their occurrence is extremely small. The protection advantage is quite similar to that gained from the bifurcated contacts used on high-quality relays.

There remains, of course, the possibility of catastrophic failure from breakdown of a critical component. The best that can be said in defense of the computer industry is that it is forced by its own circumstances to be extremely sensitive to the reliability problem. The vast majority of installations are at locations where the personnel in attendance are completely unfamiliar with electronic circuitry. As a result, all computer manufacturers offer extensive field maintenance service, and have fully-developed preventative maintenance routines. The newer solid-state equipment has been establishing remarkable performance records. In on-line process-control applications, the reliability requirement might perhaps be considered almost equal to that of the broadcaster, when it is recognized that computer failure might blow up a boiler or cause some similar inconvenience.

Conclusion

In summary, the use of a digital computer for television automatic switching control permits almost complete freedom in the development of whatever man-machine relationship proves to be best for the application. Data entry and display systems can be tailored to whatever is considered the ideal arrangement for efficient and accurate operation. To provide an equivalent solution to the requirement of data accessibility with heretofore-used techniques would be prohibitive in cost even for a relatively small-capacity system. The inherent versatility of the approach provides opportunities for progressive adaptation to changing operating requirements at lower cost and less inconvenience than possible with special-purpose equipment. Numerous possibilities exist for the addition of data processing functions related to the program schedule.

A computer system based upon the described concepts, developed for CBS by TRW Computers Co. was put in operation on December 31, 1960, at CBS TV station KNXT, Los Angeles, California. The equipment, including display panels, is housed in two equipment racks. Provisions are made for controlling a 21-input audio/video switcher, several auxiliary preselect switchers, twelve film projectors and four video-tape recorders. The memory space allocated for event storage provides an initial capacity of 220 events, with an ultimate expansion capability to the order of 1400 events, if the future operating situation should so require. A more complete description of this particular system is planned for publication in a separate paper*

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* To be presented at the 1961 NAB and 1961 Spring SMPTE Conventions.

Automatic-Sequencing Equipment for Television Operation

By F. CECIL GRACE
and CHARLES E. SPICER

An automatic television program system has been designed wherein events are stored in beam switching tube memory elements, along with the time each event is to remain on the air. As each event goes on the air, its time begins to count down 10–9–8–7, etc., to zero. When it reaches zero the next event is automatically switched on the air and its allotted time starts counting down. In case the operator desires to cut short an event which is on the air before its alloted time expires he may do so and immediately place the next upcoming event on the air by pushing a "take" button on his control panel. Similarly if he desires to extend the allotted time of an event on the air he may push a "hold" button which will stop the countdown, allowing the on-air event to continue until he is ready to put the next event on the air, which he does by pushing the "take" button. This provides split second automatic timing with straightforward manual override.

NOW THAT television program automation equipment has been successfully used at a number of stations[1,2,3] and that such equipment is being offered by a number of companies,[4] it is no longer necessary for a paper on the subject to show that the use of program automation has advantages over an all-manual operation. It is, however, pertinent to classify program automation systems in accordance with their general method of working, in order to show how the system to be described fits into the general scheme.

A natural first thought about program automation systems is that they should provide for performing switching functions at preset times; e.g., take Studio A at exactly three o'clock, take Video Tape 2 at exactly ten seconds after three, and so on. Actually, such a system would have very limited utility. All too often some event does not finish on time, and several subsequent events must be delayed. Or perhaps some program source is producing a very poor picture, and it is decided to cut it short. Then different events must be inserted in the network break. The network has previously advised the length of the break but not the time it will start, since it will be timed to coincide with an intermission in a sporting event being covered. Obviously, true time is useless for these situations.

There are, however, three basic systems which are useful. Innumerable variations are possible with each of the systems.

The most complex of the three is a true-time system as described above, but with means for advancing or retarding the control clock at will, to take care of situations such as mentioned above, and then resetting it instantly to the correct time. Special provisions must also be made to cover the "floating network break" described above.

The simplest of the three is the manual operate preset system. In this version there is no timing equipment at all. After storing or "presetting" a sequence of events, the operator pushes a button each time a switching operation (called an "event") is to take place. The advantage over straight manual operation is that the operator achieves all audio and video switching by repeatedly pushing the same button, putting on the air the sequence of events which has been carefully preset and so he is not apt to make a mistake. Such systems have been described in previous papers.[1,5]

The third system, intermediate in complexity between the other two, is the elapsed-time system or "count down" system. In this system, the operator stores a sequence of events and enters, along with each event, the number of seconds that event is to remain on the air. Ordinarily such a system is used only to time automatically groups of closely spaced events, such as occur at station break times and other "panic periods." During long events, such as studio shows, network operation and feature films, the timing equipment does not operate, and the automation equipment waits for the operator to press a "take" button at the end of the long event. When he does so, the next upcoming sequence stored begins and its first event goes on the air. At the end of the time allotted to that event, the following event goes on automatically, and so on, until, the complete stored sequence being over and another long event having been put on the air, the timing equipment is stopped automatically and the equipment waits for the operator to press the "take" button again. Obviously, such a system can easily handle the "floating network break."

If such a system is also provided with a clock which will start such a sequence at a predetermined time (called "true time") and even further is provided with a device to detect signals at the end of film or video tape to also start such a sequence (called "feedback"), then we have covered all possible automation techniques.

This is the system that will be described in this paper.

Description

The Visual Electronics "Spot Saver" automation equipment consists of a group of "building block" units mounted in a standard equipment cabinet, Fig. 1. The heart of the system is the storage-display, Fig. 2, lower section. The units contain the information storage and most of the circuitry, and all stored information is displayed on their panels. All except the top and bottom horizontal lines are identical, and each of these identical units has a storage capacity of three events, one event in each horizontal line. If additional capacity is required, it is only necessary to add more of the

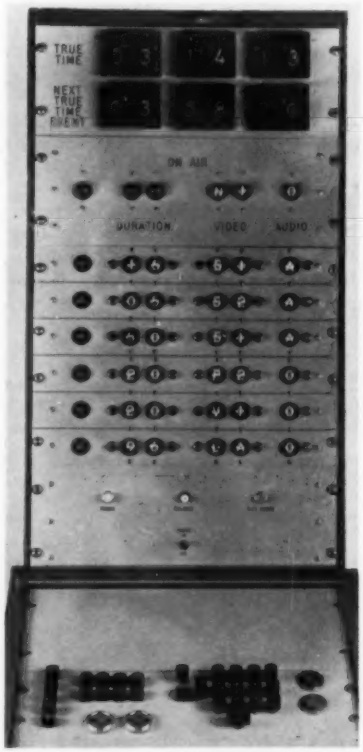

Fig. 1. Spot Saver automation system, Visual Electronics Corp.

Presented on October 8, 1959, at the Society's Convention in New York by F. Cecil Grace, Visual Electronics Corp., 356 West 40 St., New York 18.

(This paper, with basic circuitry, first received Oct. 8, 1959; in final form on March 7, 1961.)

units. The on-air situation is displayed above the storage display and the true time clock system above that, Fig. 3.

Since this equipment carries the display of information it must be installed in view of the operator. However, with the exception of the power switches and of buttons for making changes or corrections to the stored information, there are no controls on the panel. All controlling and setting in of information is done at the keyboard shown in Fig. 4, normally mounted in a control console.

Other necessary equipments are the power supplies and the relay panels for automatically operating the station equipment, plus paper tape units for providing all-day programming of the system (see block diagram, Fig. 5).

System Operation

The automation system to be described uses a "shift" storage and display system. Since this has been described in previous papers,[5,6] it will be described only briefly here.

The display panels (Fig. 3) contain horizontal lines of indicators, five to each line. Each line represents one event. The two indicators on the left are digital tubes called "Nixies." In operation they form a two-digit number which is the number of seconds the event is to remain on the air. The two indicators in the center are letter or number Nixies to indicate the video source of the event. The single indicator on the right is a Nixie to indicate the audio source (a single indicator is used since most audio sources are the same as video and can be designated by one number).

By using the keyboard (Fig. 4) which is located in an operator's console, an event is set in the bottom row. The operator can check the event, and if it is in error, he can correct it from his remote panel. When he is satisfied that it is correct, he pushes a release button. The event then shifts all the way up to the top row, which is the row for the next event on the air. The next event the operator sets in again appears on the bottom row. After it is checked and released, it shifts up to second row, which is the row for the second event. All the other events are similarly stacked in, appearing first at the bottom and then shifting up to fill the topmost open row.

All stored events are now displayed on the panel in view of the operator in the sequence in which they will occur, reading always from top to bottom. Events can still be changed at any time by pushing the correction button next to each indicator. When this is done all the numbers on the Nixie appear in sequence, and the operator removes his finger from the button when the correct indication as been reached.

Let us suppose that a typical "panic period" sequence has been preset. Assume that the first event calls for video on slide one, audio on announce booth, and that this event is to last 12 seconds. To begin the sequence, the operator presses his "take" button. Three things happen immediately:

(1) The video switcher is switched to slide one.

(2) The audio switcher is switched to the announce booth.

(3) The timer in the automation equipment is started.

Visible evidence is provided in the On-Air Panel of the automation system that these things have been done. It will be noted from Fig. 1 that this row is spaced away from the others. The video and audio indicators on this row are connected to the tally light circuits of

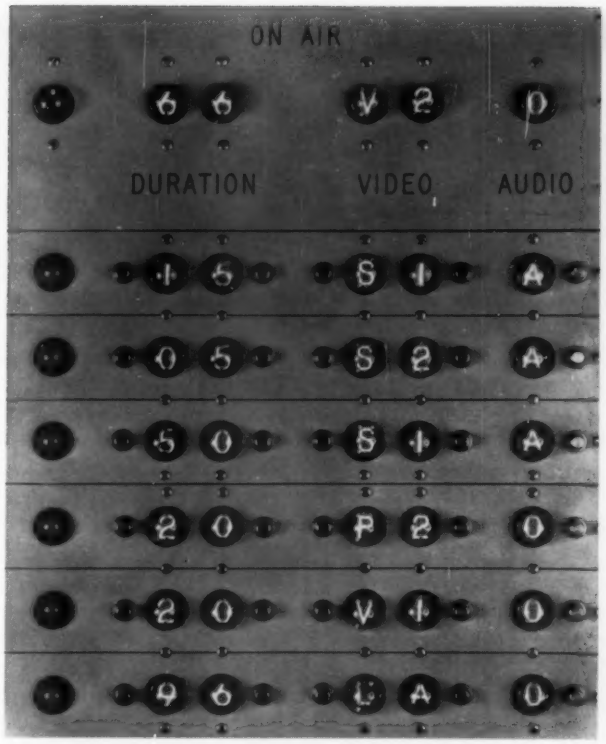

Fig. 2. On-Air panel,[1] top; storage display for six events below.

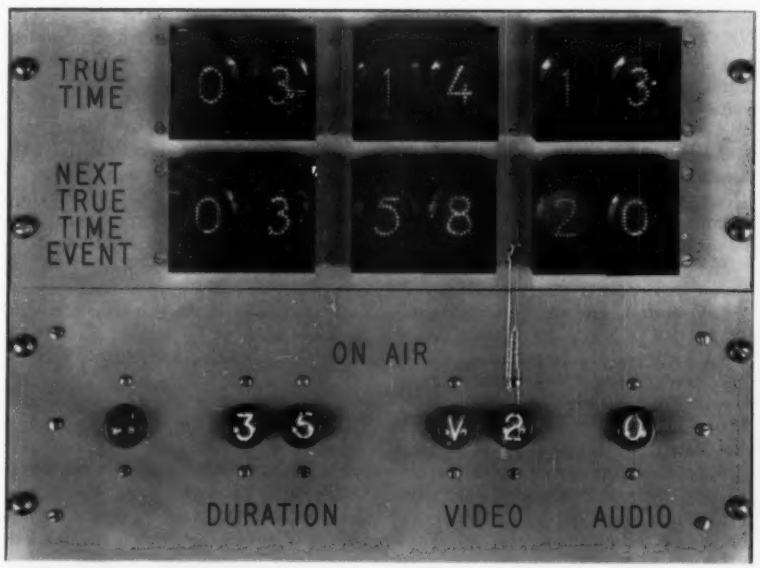

Fig. 3. True-Time panel, top; On-Air panel below.

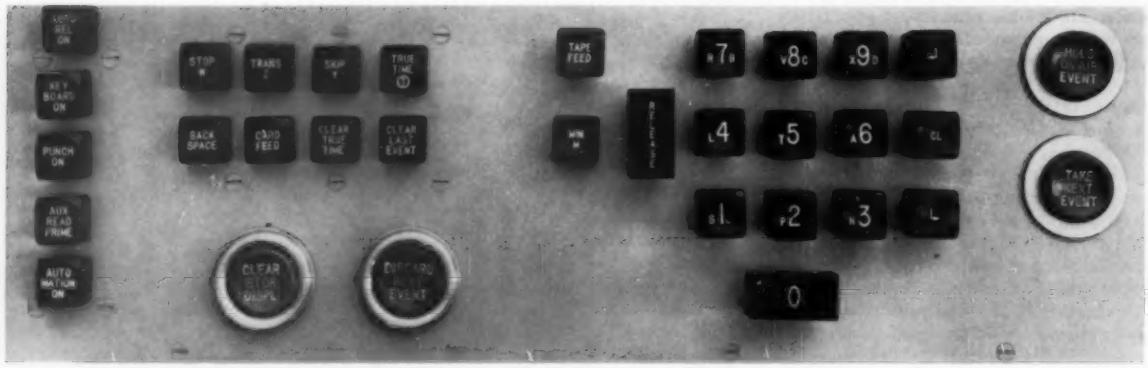

Fig. 4. The keyboard provides for the following: (1) manual "Take Next Event" and "Hold-On-Air Event" (right side keys); (2) manual event insertion into the storage display (right center keys); (3) punching of events into paper tape with display acting as read-out (manual event keys plus left side setup keys); (4) setting the system for use with paper tape equipment (left side keys).

the video and audio switchers. Thus they always show what is on the air, regardless of whether it was put on the air by the automation equipment or manually. (The manual pushbutton panels of the audio and video switchers are left in the circuit, and can be used at any time.)

This, then, is the panel evidence of the switching. The evidence of the start of the timing is provided by a special tube called a "Pixie" which is located on the left end of the row. It is a neon glow tube. The anode is the plate with the ten numerical perforations. Each is connected to one target of a beam switching tube counter. This counter is connected to a frequency divider which produces 10-cps pulses by counting down the 60-cycle power line six to one.

Before the operator pressed his "take" button, there was no beam formed in the beam switching tube of the counter and therefore no glow in the "Pixie." As soon as the button was pressed, a beam was formed on the zero target, and the "0" on the Pixie was lighted. One tenth of a second later, the beam switched to the one target, and the glow on the Pixie transferred to the "1" position. And so on every tenth of a second. From a distance, one cannot read the small numbers on the Pixie, but one does notice the glow moving around the circumference at a rate of one revolution per second.

The above described action takes place immediately on pressing the "take" button, but there is additional action that takes place automatically about one third of a second later. This is the "shift" action previously mentioned. The indication of 12 seconds for this event, which was in the top event row, now transfers up to the two Nixies directly above, in the row with the on-the-air lights, while the two neon clusters, which were displaying the event already placed on the air, go out. Then all other events below shift up one position so that again we have a display in which the next event preset to go on the air is shown on the top row, the second event on the second row, and so on.

All this action is completed long before the first second has elapsed, and so the glow on the Pixie has not completed one full circle. As soon as it does so the 12-second event now on the air has only 11 seconds to go, and so the digits to the left of the on-the-air lights, which actually indicate the time to go, change to 11. This is possible because the beam switching tubes which operate these Nixies are arranged to count subtractively, that is target 9 is used for "one," target 8 is used for "two" and so on. The beam switching tube that operated the Pixie develops a carry pulse each time it reaches zero (that is, once a second) and this deletes one second from the units digit of the remaining time. When the units digit reaches 9, it in turn develops a carry pulse which subtracts one from the tens of seconds digit.

Thus the on-air time indicator counts down 5–4–3–2–1, and finally 0. When both digits reach zero it is time to put the next event on the air. An "and" circuit connected to the two zero targets detects the fact that zero time has been reached, and initiates the switching to the next event. One third of a second after the switching is accomplished we again have a shift of the information on the panel, so that again we have a display with the next preset event in the top row, and again the time the new event is to be on the air has reached the subtractive counter and is ready to count down.

Thus the equipment works automatically, switching on each event in sequence for its allotted time, until the next untimed event is on the air. Naturally there has to be some way of indicating to the equipment that a certain event is untimed and that nothing further is to be done by the on-air timer. We use two codes in the duration column to do this. Code 96, when it reaches the On Air Panel, stops the timer and clears the indicators. The next switch then must be made manually or, if a time is indicated in the True Time Panel, will be made automatically by the true-time clock. Code 97 stops the timer but remains in the indicators. This shows that the next switch will be initiated by the feedback device on the particular film projector or video-tape machine now on the air.

If timed events of over 60 seconds are to be entered, the duration column is caused to indicate minutes, by operating a minutes button on the keyboard. A minutes light to the left of the duration Nixies lights to show that they are now read as minutes. The circuit which accomplishes this matrixes the "seven" and "eight" in the tens duration column to read "zero" and "one" and lights the minutes indicator light. Thus minutes duration up to 19 can be inserted. When this duration is 5 minutes 40 seconds the 40 seconds is entered as another event. It is entered with the same video and audio so that at the event shift from minutes to seconds nothing happens on the air.

Keyboard

The keyboard which is normally mounted in a console, is shown in Fig. 4. A cluster of event setting keys right of center sets the events into the panel. The same keys are used for setting time, video and audio, and are therefore marked with both digits and switching abbreviations. The keyboard sets the bottom row of the automation panel from left to right, that is, the first key touched sets tens of seconds; the next, units of seconds; the third and fourth video; and fifth, audio.

After the operator has completed setting in one event, he can check it by looking at the display panel. If it is correct, he touches the release key with his thumb, and the event shifts up to

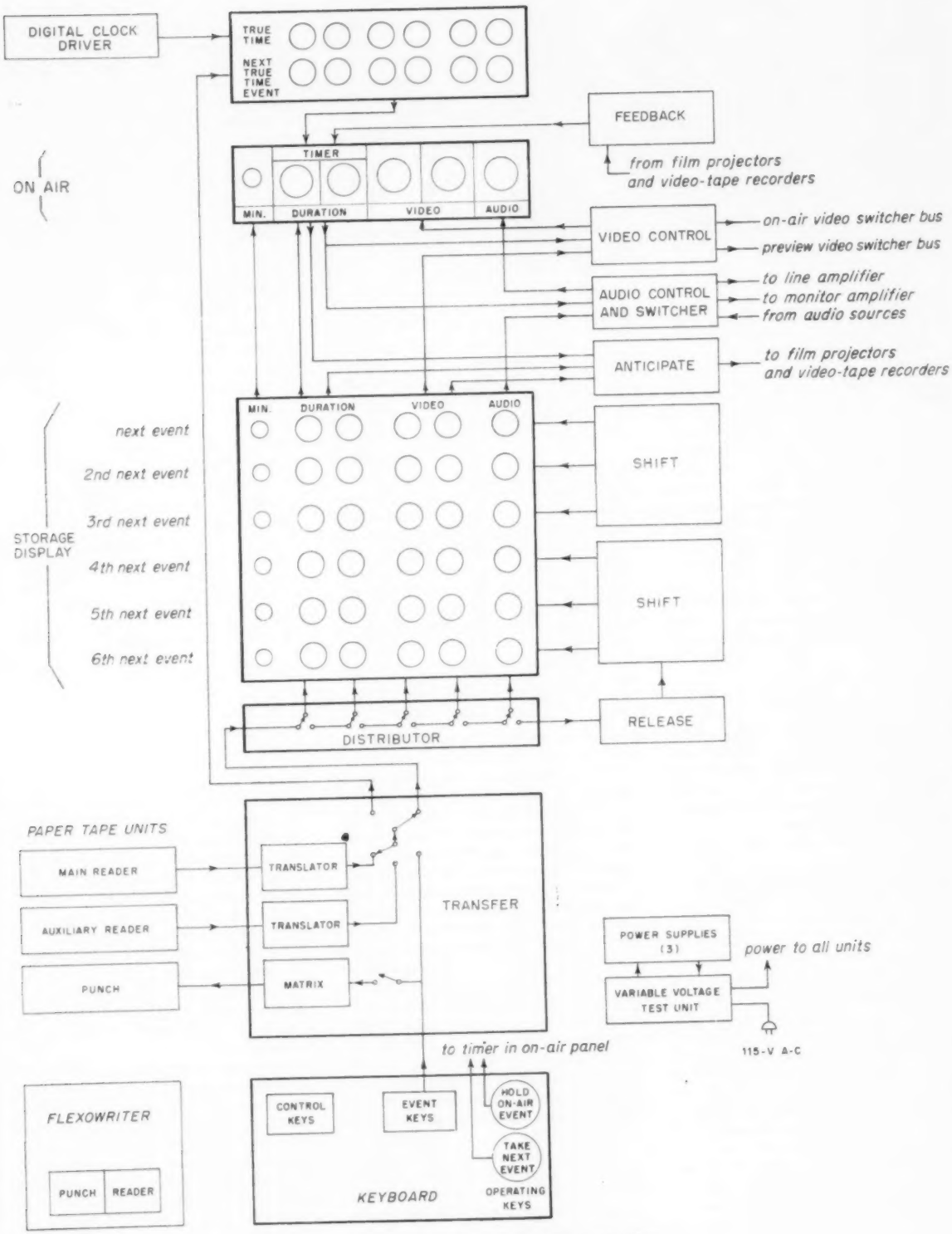

Fig. 5. Block diagram of Spot Saver Television Automation System, Visual Electronics Corp.

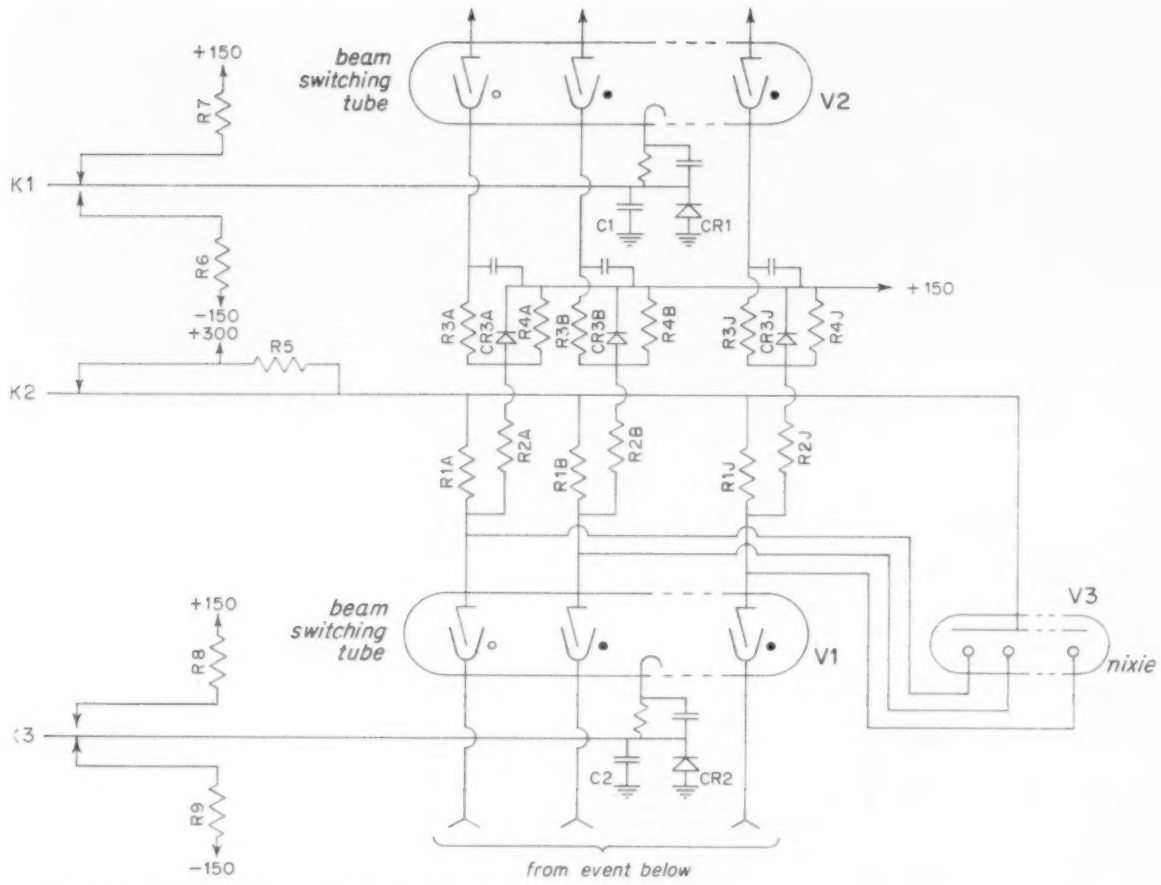

Fig. 6. Simplified storage, display, and shift circuit.

the uppermost vacant row as previously explained. If, on the other hand, it contains an error he touches "clear last line" and resets the event.

After he has become skillful, he can press the automatic release key (left side). In this case each line goes up as soon as it is full, with no need to touch the release key.

To the right will be found the "take next event" button, which performs the function previously described. It can perform another function as well. In case an event ends sooner than expected, it will be desired to go on to the next event early. Pressing the "take next event" button while the timer is running causes the next event to go on the air immediately. At that time the timer is reset to zero, so that the next event will run for its full prescribed time.

Sometimes an event may take longer than expected. If it appears that the automation equipment is going to take an event off the air before it is finished, the operator may avert this by pressing the "hold on air event" button, which is just above the "take" button. This stops the timing system. When the event finally ends, the operator presses the "take" button, which puts the next event on the air and starts the timing again.

The keys on the left side of the panel are used when the system is operated by standard one-inch, eight-hole, punched paper tape. By pressing the "Punch On" key, the keyboard is made to operate a tape punch (not shown) as the event keys are operated. In this mode of operation the storage display is used as a readout to check the punching of the tape. The tape can be prepared for a whole day's schedule and then inserted in a tape reader (not shown). When the "Keyboard On" key is released, the system takes its input from the tape reader which then automatically feeds an event into the bottom event line each time it clears after the top event has gone on the air.

Although changes are easily made in the storage display in the half-hour before a break goes on the air, an additional technique is provided for making changes later on in the day. Here a change is punched into a segment of tape which is inserted in an auxiliary reader. "Stop" and "Transfer" keys are used to insert the code "WZ" in the main tape at intervals of 15 to 30 minutes. On reading this code, the main reader automatically interrogates the auxiliary reader. If it is primed (either by previous operation of the "Auxiliary Reader Prime" key or by the timing unit, not shown) then the system input is automatically switched to the auxiliary reader, and the main reader proceeds to the next WZ code and stops. When the auxiliary reader reads code Z, the input is switched back to the main reader. If there are two consecutive change segments in the auxiliary reader, code Y is inserted in the auxiliary tape. This causes the main reader to skip to the next WZ code.

The paper tape can also be prepared in the station's traffic department as a by-product of typing the day's operation schedule on a Flexowriter. The Flexowriter is basically an electric typewriter with built-in tape punch and tape reader. Such an operation provides many subsidiary advantages because it ties in with other data processing equipment, but a discussion of the techniques would be too lengthy for this paper.

Advantages of the "Shift" System

The electronic "shift" storage and display system has a number of advan-

tages. The fact that, at all times, the next event to go on the air is on top, and the event to go on the air second is just beneath it, etc., always presents the upcoming sequence to the operator reading from top downwards, thus avoiding errors. A further advantage is that new information may be fed into the panel any time it is not completely full. Any event set in always shifts from the bottom row to the uppermost vacant row. This makes it possible to set this equipment from punched cards, punched tape, or similar devices which can hold a whole day's programming. With such a combination, the tape or card reader can keep the automation panel full, and the panel serves to display to the operator the next several events sufficiently ahead of their use to allow him to check them and correct or change them if necessary.

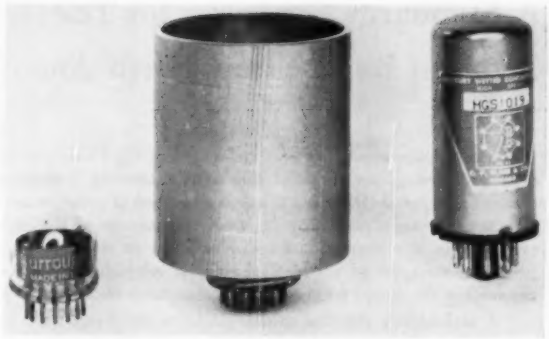

Fig. 7. Nixie indicator, left; beam switching tube, center; and mercury-wetted platinum contact relay used in storage display and On-Air panels.

Circuit Details

Unfortunately, space does not permit a detailed description of how everything works. Particularly to be noted is the unique circuitry for the storage, display and shift of information (Fig. 6) which operates as follows:

The shift of information up the board, which is the key feature of this automation system, is actually a sequential copying, by each event storage device, of the information stored in the device immediately below it.

The event storage devices are beam switching tubes, which have been described in the literature.[7] The circuitry which permits one beam switching tube to copy the information contained in the one below is a modification of previously used transfer-storage circuitry.[8] Figure 6 shows the circuit used. V1 is a beam storage tube containing information. Relays K1, K2 and K3, of which the coils are not shown, are bi-stable, mercury-wetted contact types. K3 is making contact to R9, and current is flowing through diode CR2, so that the cathode bus of V1 is at ground potential. If the information stored in the tube is that associated with target No. 2, then this target is drawing current, and the drop across load resistor R1B lights cathode No. 2 of the Nixie indicator tube V3.

The ten targets of V1 are coupled to the ten spades of V2 through resistors R2A through R2J, in series with resistors R3A through R3J. The values are such that the junction of these resistors would have a potential greater than 150 volts. Therefore, current flows through the diodes CR3A through CR3J, which clamp these points to +150, eliminating the coupling.

Transfer is effected by first operating relay K1 to the position contacting R7. This brings the cathode line of V2 to plus 150, clearing the tube of any information it may contain. Then K1 is operated to the other position, simultaneously K2 is opened. C1 discharges through R6, bringing the cathode line gradually down to ground potential. When ground potential is reached, diode CR1 clamps the cathode line to ground.

As C1 discharges, the spade-to-cathode voltage of V2 gradually increases from approximately zero to the normal value. At some value in this range the tube goes through a condition of increased sensitivity to beam formation. Meanwhile the opening of relay K2 has placed resistor R5 in series with the target circuit to V1. Since beam switching tube targets have constant current characteristics, the effect is a further drop in the potential of the conducting target, in this case No. 2. CR3B no longer clamps to +150, and spade No. 2 of V2 will be at a lower potential than the other spades. The beam will, therefore, form in V2 to target No. 2.

The sequencing through all ten beam positions that occurs when the correction button is pressed is achieved by the grids in the beam switching tubes, using conventional counter circuitry not shown in Fig. 4. Except when a correction button is pressed, however, the grids are returned to plus 150 volts for maximum stability.

No attempt was made to design either an "all electronic" or an "all relay" device. Instead the choice was made for each function between relays and electronics, whichever was most appropriate. For example, beam switching tubes (Fig. 7) were used for information storage because of numerous advantages. Having ten beam positions, each tube can hold a considerable amount of information. They can operate read-out devices (Nixie indicators) directly. They can drive the output relays directly. They have long life and great reliability. And finally, they lend themselves very well to the "shift" storage system.

Producing the shift of information could have been achieved electronically, using complicated and expensive high-voltage transistor circuitry, or using large tubes dissipating a great deal of power. Instead relays were used, since they do the job easily. The relays used for this purpose are of the mercury-wetted contact type. They have an extremely long life and high reliability. They are of a bi-stable type of high sensitivity: only 2.5 mw is required to transfer the contacts from one side to the other. This permits their control by small computer-type dual triodes operating at low plate dissipation for long life. Two of these are required for each event, and six more in the control equipment. They are plug-in units and all are identical, which simplifies the stocking of spares.

The authors wish to acknowledge gratefully the contributions of David Glaser, who developed the coupling circuit between beam switching tubes, and Daniel Schacher, who developed the mechanical arrangements and also contributed some circuit suggestions.

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A Standards Converter for Television Exchanges Between Europe and North America

REPRINT

By A. V. LORD

When television recording on 2-in. magnetic tape was widely adopted by broadcasting organisations on both sides of the Atlantic, it was realised that this constituted a major contribution towards a method of programme exchange. However, the fact that tape recording involves the storage of the video-signal wave-form rather than the corresponding picture (as in film recording) poses a further problem. Because of the differences in television standards, some method of converting the signal from one set of standards to the other becomes necessary.

A satisfactory solution to this problem has been used in Europe for several years, where three sets of scanning standards (819, 625 and 405 lines) are in use. However, the common feature of a 50 cycles per second (cps) field frequency has led to a comparatively simple conversion system, and articles have been published[1–3] describing the conversion problem and equipment suitable for use in such circumstances.

Further investigations have now led to the development of a converter suitable for use between standards having 50-cps and 60-cps field frequencies.

1. General

The Basic Standards Converter

The basic arrangement of a standards converter is shown in Fig. 1. Input information is written on the storage surface of the camera tube A by an optical image of the light spot produced on the screen of the cathode-ray tube B: this may occur either directly, if the surface is photosensitive (orthicon or vidicon) or indirectly by the interposition of a photocathode emitting electrons, which in turn produce a charge pattern at the storage surface by secondary emission (image orthicon). As the cathode-ray-tube amplifier C and deflection circuits D are of the conventional form, the charge pattern at the camera storage surface is laid down in the form of a television picture conforming to the input standard. It will be appreciated that the charge representing any input picture element is accumulated at the storage surface from the moment the corresponding point on the cathode-ray tube is illuminated until all phosphor afterglow at this same point ceases.

The camera-tube scanning beam, deflected according to the required scanning standards by suitable circuit arrangements E, scans the storage surface, erasing the charge pattern and producing a video signal which, after the insertion of suitable blanking and synchronizing signals in F, constitutes the converter output.

The properties and problems associated with the standards converter have been discussed in another paper,[1] but for the sake of clarity a brief summary will be included here.

Reprinted with the permission of G. Hansen, Director, European Broadcasting Union, 32 Ave. Albert Lancaster, Brussels 18, from the *E.B.U. Review, Part A, No. 63:* pp. 209–213, Oct. 1960. This paper was originally published simultaneously in German in *Rundfunktechnische Mitteilungen, No. 4:* 1960. Mr. Lord is with the British Broadcasting Corp., Research Dept., Kingswood Warren, Tadworth, Surrey.

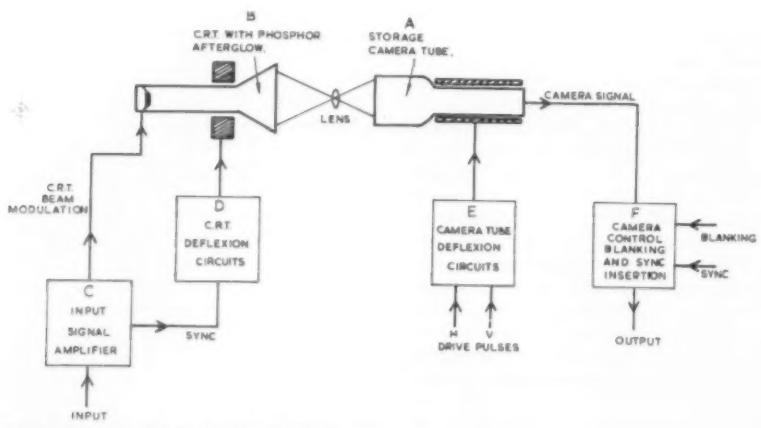

Fig. 1. The basic television standards converter.

Differing Line Standards

A difference in the number of lines per field between the input and output will cause the camera "reading" beam to cross the lines of charged elements representing the input. If these lines of charge are separated (in a vertical sense) by uncharged gaps, "beat" patterns will appear at the output. This effect may be avoided by applying vertical "spot wobble" to the scanning beam of the cathode-ray tube.

As most camera tubes effectively discharge[4] the target surface during each field scan, the amplitude of "wobble" usually applied is such as to remove the line structure of each input field.

Differing Field Standards

A difference in the frequencies at which any point on the storage surface is charged and discharged causes the charge available for *reading* by the camera beam to vary.

This problem is illustrated by both parts of Fig. 2, which show, as a function of time, the writing emission (or brightness of the spot on the cathode-ray tube) of one picture point, together with the relative timing of the reading process. In Fig. 2a the field frequency of the reading beam exceeds that of the writing beam; in Fig. 2b the writing field frequency is the higher. From the figures it will be seen that the charge accumulated (area under the curves) during any reading field period T_R is equal to the charge available during one writing field period T_W *minus* (in Fig. 2a) or *plus* (in Fig. 2b) the shaded area X embraced by the emission curve and the difference between the reading and writing periods.

The area X varies as a function of the relative timing between the reading and writing processes at a rate equal to the difference between the input and output field frequencies.

Figure 3 shows the time functions modulating the camera output calculated for conversions between standards having 50-cps and 60-cps field frequencies; in the calculations the afterglow of the cathode-ray-tube phosphor has been assumed to have an exponential decay with a time-constant of 7 milliseconds (msec). The amplitudes are plotted relative to the unmodulated output obtained for conversion between standards having identical field frequencies and it will be seen that conversion from 60-cps standard to a 50-cps standard produces a greater output (with less flicker modulation) than conversion in the opposite direction.

2. The Wide-range Standards Converter

Correction of Flicker Modulation

Correction of the camera output variations due to the field-frequency difference may be carried out by inserting, in the converter signal path, a modulator whose gain is adjusted by a suitable control signal. If this modulator is located at the input of the display cathode-ray tube, the full signal range available from the camera may be exploited, but difficulties are experienced in achieving correction throughout the whole flicker cycle.

To date the most successful results have been obtained by locating the correcting modulator at the camera output; with this arrangement a servo system may be devised which will effect correction automatically. In one such system,[5] a narrow fixed-amplitude pulse is inserted into each line-blanking interval of the input signal and displayed by the cathode-ray tube as a bright stripe down one side of the picture. The output signal from the camera will then include a corresponding pulse occurring once per line period. If the camera is operated linearly (output current varying directly as cathode-ray-tube light flux), variations in the pulse amplitude due to a field-frequency difference will obey an identical law to that governing all levels of the picture signal. Correction is applied by sampling these camera-output pulses and deriving a control voltage, which is then used to vary the gain of a suitable amplifier in such a manner as substantially to eliminate the flicker variations in the pulse (and picture signal) amplitudes.

The Converter System

The block diagram of Fig. 4 shows the standards converter developed from the above principles. The design fol-

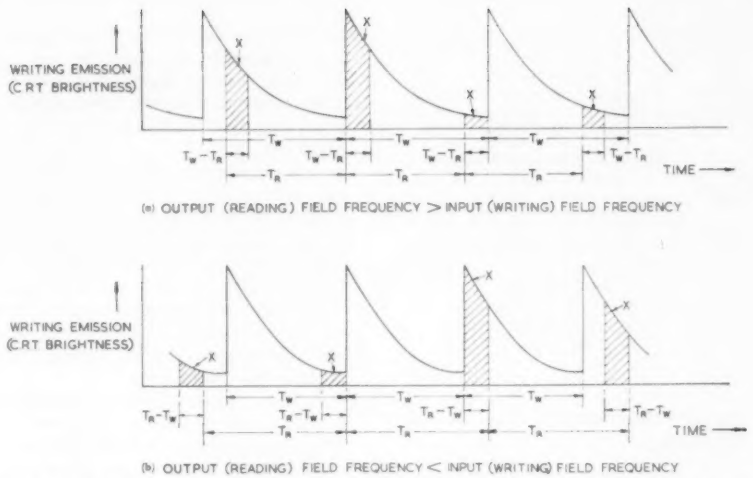
WRITING EMISSION (C.R.T. BRIGHTNESS)
TIME
(a) OUTPUT (READING) FIELD FREQUENCY > INPUT (WRITING) FIELD FREQUENCY
WRITING EMISSION (C.R.T. BRIGHTNESS)
TIME
(b) OUTPUT (READING) FIELD FREQUENCY < INPUT (WRITING) FIELD FREQUENCY

Fig. 2. The writing and reading of one picture point when the input and output field frequencies differ.

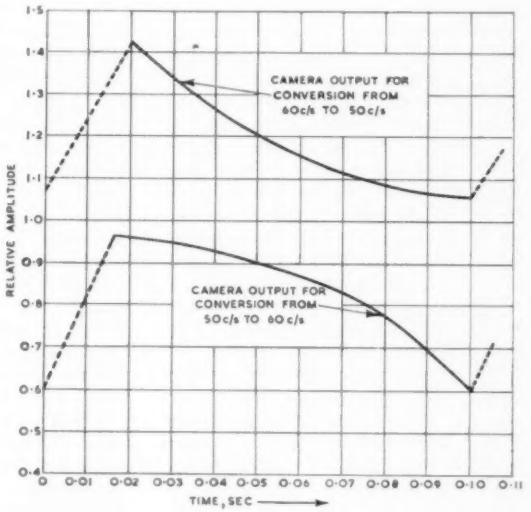
CAMERA OUTPUT FOR CONVERSION FROM 60c/s TO 50c/s
CAMERA OUTPUT FOR CONVERSION FROM 50c/s TO 60c/s
RELATIVE AMPLITUDE
TIME, SEC

Fig. 3. Modulation of camera output for conversions between 50-cps and 60-cps standards.

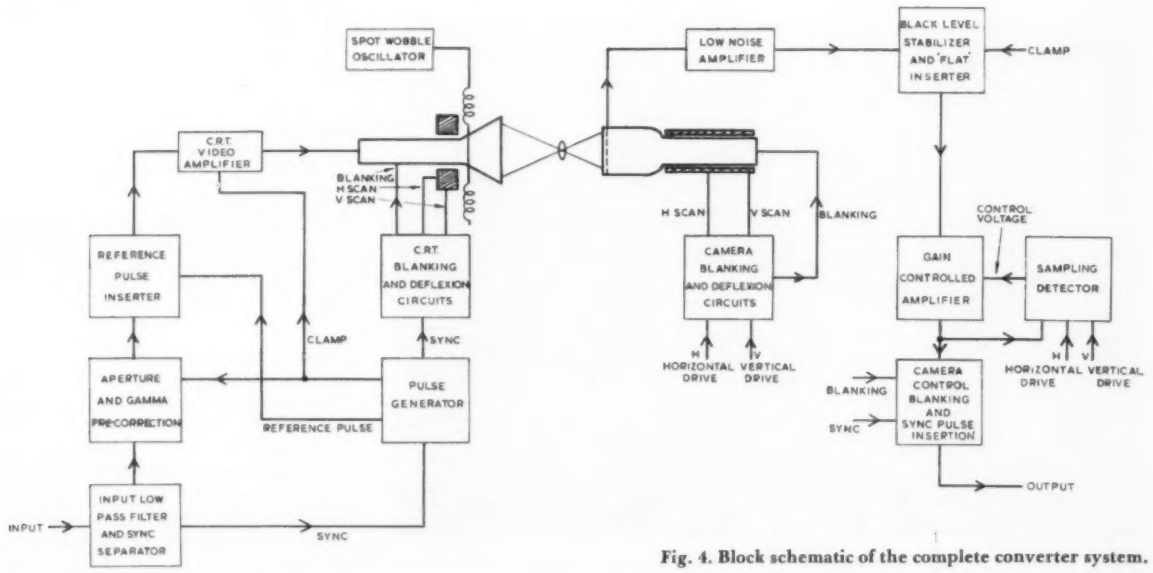

Fig. 4. Block schematic of the complete converter system.

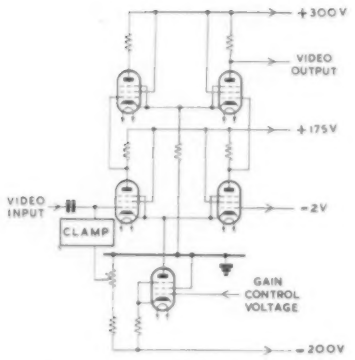

Fig. 5. Gain-controlled stage of video amplifier.

lows the basic form of Fig. 1, to which certain further features have been added.

In order to remove signal and noise components outside the nominal bandwidth, the input signal is first applied to a phase-corrected low-pass filter. Sync pulses are extracted and used for generating the various trains required for deflection, clamping and reference signal. The video signal is then pre-corrected for the aperture loss and non-linear "brightness against drive-voltage" characteristic of the display cathode-ray tube; the process of gamma correction requires a bandwidth increase which is preserved in the remaining stages of the input-signal chain. Reference pulses are combined with the video signal and an amplified version of the composite signal, including the full d-c component, is applied to the display tube. Each reference pulse has a duration of some 3% of the input-system line period and is timed to occur at the end of each picture line. Suitable timing of the display line scan, together with a short flyback interval, ensures that the display includes the whole picture area, together with the reference signal seen as a stripe down the right-hand side.

A low-power oscillator provides 20-mc "spot wobble" current to a suitable winding on the deflection yoke.

The high-quality 23-cm cathode-ray tube is operated at 25 kv and has a willemite (Zn_2 Si O_4 : Mn) phosphor whose exponential decay is characterized by a time-constant of 7 msec; the display highlight brightness has a normal value of about 33 millilamberts.

By means of a specially adapted lens, the displayed picture is focused on to the storage mosaic of a C.P.S. Emitron,[6] such that the image at the storage surface has a diagonal dimension of 55 mm. This camera tube is similar to the orthicon, but employs magnetic deflection on both scanning axes, a tri-alkali (Sb - K - Na - Cs) photo-surface and a stabilizing mesh that substantially reduces the tendency to instability with excess light. The tube exhibits a very linear relationship between accumulated charge and output current, adds no shading signals, shows a negligible tendency to "stick" and has an output signal from which the full d-c component may be recovered by clamping.

After suitable low-noise amplification, a black-level stabilizer re-inserts the full d-c component and interline pickup is removed by a blanking gate or "flat-inserter." Removal of flicker modulation follows and is carried out by an AGC system in which the gain of a video amplifier is controlled by a voltage, proportional to the reference-signal amplitude, that is derived from the sampling detector at the amplifier output. Figure 5 illustrates the circuit arrangement of a typical gain-controlled video amplifier stage. The performance of the system is such that flicker modulation

$$\left(\frac{\max - \min}{\max + \min}\right)$$

of the reference signal, and hence the picture signal, may be reduced from 30% to less than 1%.

The flicker-free signal from the AGC servo is subjected to further amplification, followed by the insertion of blanking and synchronizing signals, to produce a converter output signal according to the desired standard.

A view of the complete converter installation is shown in Fig. 6.

3. Performance and Operational Experience

The significant parameters of the various scanning and amplifying circuits of the converter are adjustable over a range covering most of the world's television standards. Full performance measurements covering all possible combinations have not yet been carried out, but some typical output characteristics are given below for a conversion from the 405-line, 50-fields/sec U.K. standard to the 525-line, 60-fields/sec U.S. standard.

(*i*) *Horizontal resolution:* 420 picture elements per line (with a "modulation depth" $\geqslant 80\%$).

(*ii*) *Vertical resolution:* Approximately 200 lines. (This is due to the halving of the vertical resolution of the input standard by the spot wobble).

(*iii*) *Signal-to-noise ratio (noise-free input):* 35 db (peak-to-peak picture signal/rms noise). Noise spectrum approximately triangular.

(*iv*) *Amplitude characteristic:* Linear over input-signal range of greater than 10 : 1. (This corresponds to an original-scene brightness range greater than 100 : 1).

(*v*) *Flicker:* Signal-output variation at 10 cps $<1\%$.

(*vi*) *Movement portrayal:* Just-perceptible image smearing and some image jerking on fast movement; the latter is fundamental and due to the difference in picture rates.

(*vii*) *Locking:* With the system described,[5] it is not necessary to lock the field frequency of the output television standard in a fixed 5 to 6 (or 6 to 5) relationship with the field frequency of the incoming television signal.

The converter has already been used operationally to provide 525-line, 60-fields/sec signals which, after recording in the U.K., were replayed and viewed in North America. Important programme material handled has included the wedding of H.R.H. The Princess Margaret and items of news and comment concerning the Summit Meetings in Paris.

Fig. 6. A complete standards converter.

4. Acknowledgments

The author wishes to thank the Director of Engineering, British Broadcasting Corp. for permission to publish the paper, and those of his colleagues in the Engineering Research Dept. who cooperated in the converter development, in particular E. R. Rout and R. F. Vigurs.

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REPRINT

Television Standards Conversion in Japan

PUBLIC INTEREST in Japan in the Olympic Games, Rome, 1960, was such that the Nippon Hoso Kyokai decided not to restrict its television coverage to the official films. Consequently, two systems of obtaining a more specialized coverage of particular events were developed. In one, tape recordings of R.A.I. transmissions were flown to Japan and there reproduced, the resulting signals being converted from the 625-line/50-field standard to the 525-line/60-field standard used in Japan and then broadcast. To carry out the conversion, two alternative processes were used and are briefly described later. The second system of transmission has a certain resemblance to the cable-film system developed by the B.B.C. for transatlantic transmissions, and involved transmitting the film, frame by frame, over the short-wave radiophototelegraph circuit from Rome to Tokyo where the film was reconstituted and televised. This last-mentioned system, which incorporates several novel features, is particularly interesting because the next Olympic Games are to be held in Japan, although it must be borne in mind that the effective delay when transporting tapes by air from Europe to Japan is the flying time *plus* the local-time difference (eight hours) whereas, for air transport from Japan to Europe, it is the flying time *less* eight hours.

For transmission over the short-wave radiophototelegraph circuit, selected items from the Olympic Games programme produced by the R.A.I. Television Service were electronically sampled so that eight pictures per second were recorded photographically on 16-mm film stock. This processing took two minutes. This film was then scanned at a rate of either thirty seconds or one minute per frame, the output being fed to the Rome radiophototelegraph terminal for transmission to Tokyo. Short-wave radio transmission has the disadvantage, compared with cable transmission, of being subject to interference arising from multiple-path propagation, which made it necessary to restrict the FM excursion to ±500 cps. This was incorporated in a special modulation process designed to minimize the effects of interference from other transmissions. This process involved using two subcarriers, one of them frequency-modulated by the even scanning lines, the other by the odd scanning lines. At the receiving end the amount of interference is automatically assessed during the vertical-blanking period and, when a particular degree of interference exists, the corresponding field is suppressed. The resulting pictures are recorded photographically on 16mm film stock, processed in two minutes and televised using a special vidicon film-scanner.

Of the two standards-conversion processes, one was essentially the same as commonly used in Europe when conversion between standards employing different field frequencies is involved.* The other process is fundamentally different in that the conversion from 625 lines to 525 lines is effected separately from and independently of the conversion from 50 to 60 fields. First of all the signal is passed through a special television tape-recorder wherein the 50-field signal is transversely recorded by two heads mounted with the proper angular relationship on a rotating disk, and the record is reproduced by another head, running at the speed corresponding to 60 fields/sec. The output is therefore at a standard of 625 lines/60 fields per second. This signal is then passed through a simple converter consisting principally of a 625-line display tube and a 525-line vidicon camera.

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* See, for instance the preceding paper by A. V. Lord.

Unusual Films: The Motion-Picture Production and Training Unit at Bob Jones University

By KATHERINE STENHOLM

The Unit produces and distributes 16mm feature-length dramatic motion pictures on religious and educational themes, travelogues, documentaries, and promotional short subjects. Comprehensive courses leading to Bachelor and Master degrees in Cinema are offered. The studio and equipment facilities are on a scale perhaps unique among institutions of higher education. Unusual Films provides the "laboratory" for practical experience in all phases of motion pictures for students in the Division of Cinema of the Bob Jones University School of Fine Arts.

Unusual Films is the motion-picture enterprise of Bob Jones University in Greenville, S.C. Realizing the importance of the motion picture for the diffusion of ideas and beliefs and the potentialities in the film as a new art form, Dr. Bob Jones, Jr., President of the University, conceived the idea of Unusual Films in 1950. The purpose was twofold:

First, to produce and distribute, under the trade name "Unusual Films," Christian and educational films that were spiritually uplifting and technically outstanding. (The studios are on a self-sustaining financial basis deriving operating and production expenses from the rental and long lease of the films which are distributed throughout the world.)

Second, to staff and equip Unusual Films in order that Christian young people who were seriously interested in Cinema could receive professional training in all phases of motion pictures while getting a liberal arts education in a cultural atmosphere. Today the Division of Cinema offers technical courses in the various fields of film production and provides opportunity for actual experience in film making through the equipment and facilities of Unusual Films.

The Facilities

Unusual Films' main building has three divisions: the air-conditioned, Fiberglas-insulated soundstage proper, 40 by 80 ft and 30 ft high; the scene-storage and machine-shop area, 20 by 80 ft and 30 ft high; and the general offices and workrooms which are divided into three stories. On the first floor are make-up, wardrobe, camera, and film-loading rooms. The second floor contains the director's and production offices and the editing, recording-machinery and sound-mixing rooms. The third floor is divided into a film storage and checking room, the art and drafting room, the distribution and advertising office and a classroom which doubles as a projection room.

This building is located directly behind the University's Rodeheaver Auditorium, and many of the auditorium facilities are used frequently by Unusual Films. The studio's scene-storage room on the ground floor connects with the auditorium scene shop where much of the smaller film scenery is constructed. Larger sets are assembled either on the soundstage (Fig. 1) or in the University shop building. Directly off the scene shop are the property rooms, armory, furniture storage, and large rehearsal halls.

From the second floor of the Unusual Films building a door opens to the auditorium stage, which is 165 ft from wall to wall and 65 ft from the stage floor to the grid, with a proscenium opening 30 ft high by 45 ft wide. On the stage left is a scenedock and loading area 40 ft square. The stage is equipped with three turntables and five lifts which were designed for the Center Theater in New York as the world's largest screw-type lifts and were purchased by the University when that theater was razed in 1954. Two lifts handle sections of stage floor 9 ft deep and the entire width of the proscenium opening. These sections can be lowered to the level of the ground floor or raised to a height of 12 ft above the stage level. The grid is rigged with two motor-driven contour curtains and 35 sets of lines for hanging drapes and backdrops. On one set of lines an 18 by 24 ft perforated screen is rigged for public film showings. The Eastman 16mm, Model 25, carbon arc projector with a $2\frac{3}{4}$ focal length lens is located in the projection booth. Simplex Arc projectors in 35mm are also available.

The University's collection of costumes, armor and jewelry, now valued in excess of $250,000, is readily adaptable for use in motion pictures, the Shakespearean plays, grand operas, religious plays and other University performances. When new costumes are needed for a motion picture, they are created in the costume room, at the expense of the film department; and after the production, they become part of the permanent University collection.

On an exterior studio lot, Unusual Films has a set which can be used for Grecian and Roman public buildings and squares and Palestinian streets and buildings. Space is provided in this set for storage of large soundstage scenery and heavy specialized equipment.

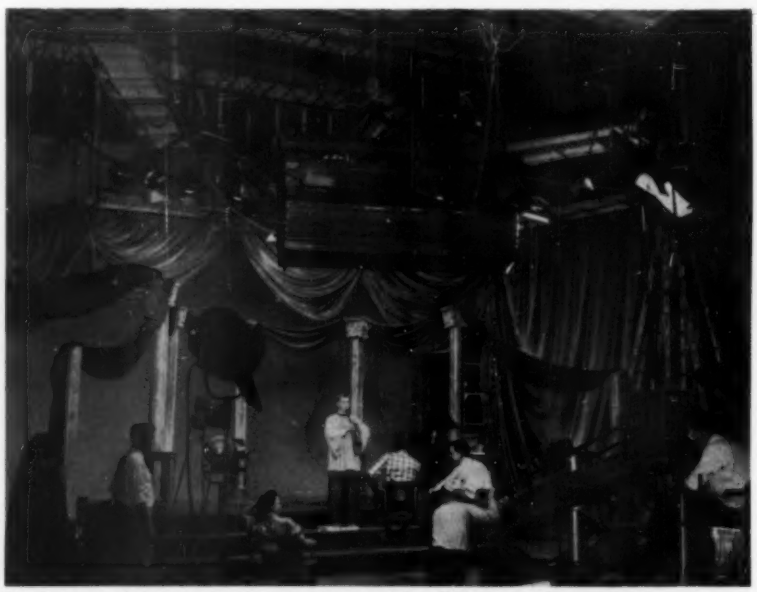

Fig. 1. A soundstage set for the sacred musical film "Heavenly Harmonies."

Presented on October 20, 1958, at the Society's Convention at Detroit, by Mrs. Gilbert Stenholm, Unusual Films, Bob Jones University, Greenville, S.C.
(This paper was received on October 8, 1958, with additions on February 20, 1961.)

Fig. 2. Types of power cord used at Unusual Films: (left to right) wall plug to twist-lock; stage plug to twist-lock; twist-lock drop cord; twist-lock to stage plug outlet; twist-lock to duplex outlet. Aluminum casting protects stage plug receptacle.

The Electrical System for Unusual Films

The transformers are rigged for a 120-208 Y-Delta hookup. Four outlets on the soundstage are located about 20 ft from the corners and each is supplied 300 amp of current. For shooting on the auditorium stage there is an additional 300-amp outlet to supplement the stage lighting facilities. A 50-ft flexible No. 2 A.W.G. 4-conductor Neoprene cable plugs into the outlets and brings the current to a spider box where it is split up and fed into three sets of outlets, each fused for 100 amp. The spider cables have the Mole-Richardson 4-hole plugging box on one end and a standard 100-amp stage plug on the other. In addition to these cords, a large number of No. 8 A.W.G. 2-conductor drop cords are fitted with twist-lock plugs. In order to increase the usefulness of these drop cords, the following adapters were made: wall outlet to twist-lock, stage plug to twist-lock, twist-lock to duplex outlet and twist-lock to stage plug outlet (Fig. 2).

About two years after the studio was opened, a 400-amp a-c–d-c motor generator unit was installed to supply direct current. To eliminate any objectionable conducted noise, this generator was mounted on cork slabs; however, because the airborne noise penetrated the soundstage walls, an air-cooled blimp had to be constructed around the motor generator. After all the mechanical noise was eliminated, the burning carbons in the Molarc produced a high-frequency squeal. The addition of a low-pass filter, fabricated from several capacitors and an old transformer used for inductance, eliminated this noise.

The basic lighting units consist of Dinky-Inkies, Babies, Bell lights, Juniors, Seniors, Color-Trans, Tenners and the Molarc. In addition to these, four units have been built to meet special needs (Figs. 3 and 4). The first consists of two large photoflood banks that can be assembled on reflector stands as 18-kw fill lights or disassembled as strip lights for illuminating backdrops. The second unit, called "bathtubs," is actually a pair of 12-kw skylights, patterned after some made by M-G-M. Two large shadowless fill lights, made in 1957, compose the third unit. A set of four 20-ft Trol-e-duct strips using snap-in lamp sockets and powerstats operating up to 200 v makes up the fourth unit. All in all, over 222,000 w of different types of lighting units are available. For location shooting, there is a 25-kw a-c mobile generating unit powered by a 4-cylinder Leroi gasoline engine and a Heil trailer on which are mounted two 280-amp d-c generators driven by 6-cylinder Chrysler diesel engines.

Production Equipment

As the demands have arisen, the staff has made a great deal of its own specialized production equipment. In the field of light control (Fig. 5) the following have been designed and constructed: gobos, flags, blades, flag scrims, cookies, gobo clamps and extension arms which fit either baby stands or high-boy stands, a special scaffold clamp, and single full- and half- and double full- and half-scrims for all the lights. For ease in rigging equipment, the following have been engineered and built: 224 ft of lightweight scaffolding in units 7 ft long with bucks, chains and safety ropes which can be rigged in a matter of minutes by only two men; sleds; light hooks; extension arms; junior to baby adapter pins; wall clamps; reflectors; and reflector stands.

A great many pieces of specialized camera equipment have been built in the studio machine shop (Fig. 6). Among these are a revolving camera device that spins the camera around the lens, a vibrating cage that gives an earthquake

Fig. 3. Production shot from a television series filmed on Unusual Films soundstage. General illumination is provided by photoflood strip lights (top) and 12-kw "bathtub" skylights.

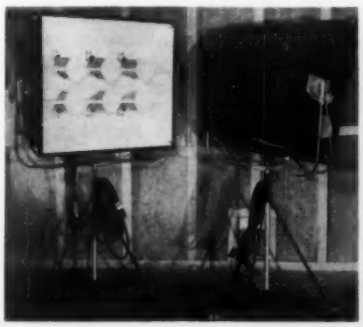

Fig. 4. Six-kw shadowless fill lights. Each bulb is controlled by an individual switch.

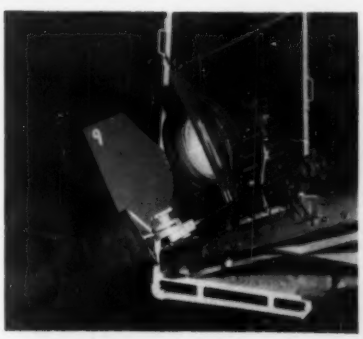

Fig. 5. Mounting plate, Century stand clamp and extension arm support flag or scrim.

Fig. 6. Studio machine shop: crab dolly under construction in foreground; revolving-camera cage on workbench.

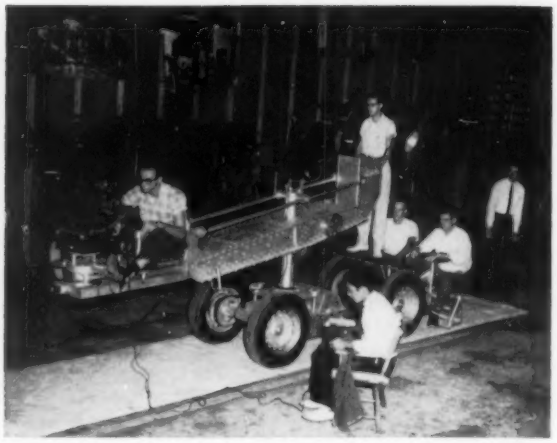

Fig. 7. Nine-foot camera crane rebuilt by Unusual Films staff to operate like M-G-M's Ro-boom. Note selsyn follow-focus system operated by student in foreground.

or an explosion effect, two camera blimps, a selsyn follow-focus system for the Mitchell blimp and a multi-directional crab dolly. The ground section of the camera crane has recently been completely changed and its operational features patterned after M-G-M.'s Ro-boom (Fig. 7). In the construction of this equipment many aluminum and iron castings were used; the patterns for these were made in the University wood shop (Fig. 8). Scenery and scenic effects have offered a number of problems that have had to be overcome by other studio-built equipment such as a wind machine that was made up from a 5-hp d-c motor and a 4-bladed racing plane propeller, a large cyclodrum for moving shadow effects, and four counter weighted set-jacks for handling wild scenery.

Numerous scenic effects have been produced on the Unusual Films soundstage—fog, rain, fire, explosions, water fountains, cobwebs, lightning, etc. However, one of the most interesting challenges was that of shooting a scale model of a Roman grain ship. All aspects of slow-motion photography had to be considered. The boat was built to the minimum practical scale of one inch to one foot; the oars had to operate in an egg-shaped path and at a fairly rapid speed so that a camera speed of 96 frames/sec would make them appear to be oscillating at the right speed of 1 revolution/6 sec; the viscosity of the water was reduced by adding a strong wetting agent so that whitecaps and froth were easily produced; and the raindrops had to be fine enough to appear to be in proportion to the scale.

A V-shaped lake 30 ft wide by 60 ft long was built on the soundstage and filled with 3 ft of water. The camera was mounted behind a porthole 6 in. above water level. Oil drums then were manually pushed up and down in the water, producing the conflicting wave motion (Fig. 9).

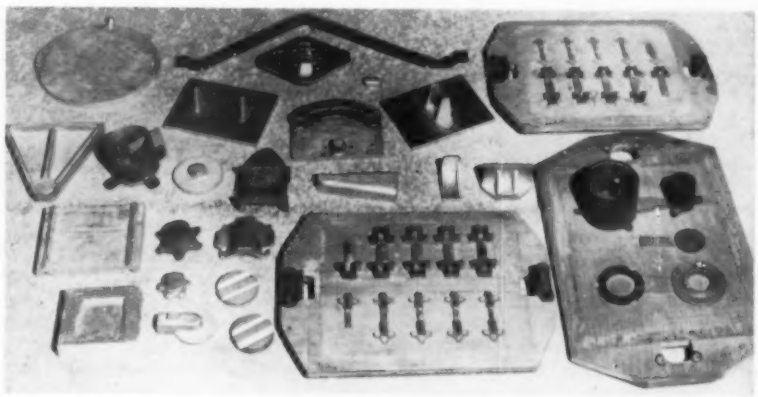

Fig. 8. Patterns for castings for studio equipment, made in studio wood shop.

Fig. 9. Process tank built on Unusual Films sound stage for shots of Roman grain ship model. Mitchell camera with high-speed motor is mounted under canopy at left.

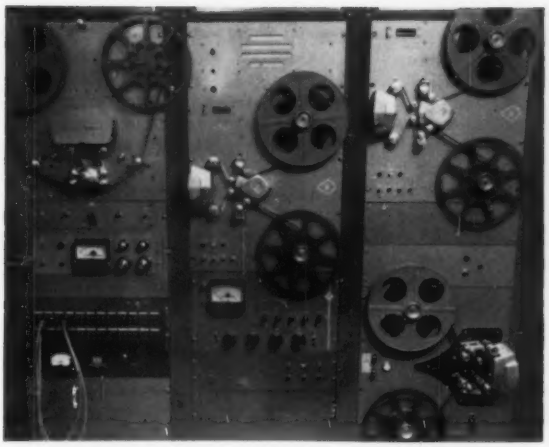

Fig. 10. Stancil-Hoffman sound-equipment installation at Unusual Films. Shown are: (left to right) Stancil-Hoffman S7 recorder/playback, S5 recorder/playback, and S5 (top) and S4 dummy playbacks. Altec compressor amplifier is installed below patch panel at left.

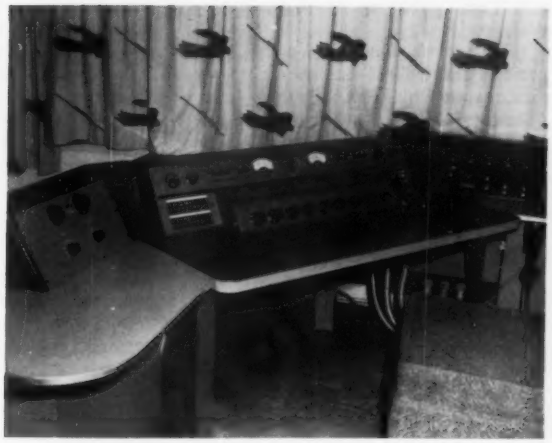

Fig. 11. Modified Western Electric console in re-rerecording room. Left bank contains a Cinema Engineering filter and equalizer; right bank contains all machine relay controls.

The Sound Studios

The sound studios had to be designed for convenience and flexibility in carrying the sound of a picture all the way from the shooting stage to the final optical transfer. They also had to be arranged so that students could learn by using the equipment from the beginning course through the graduate level.

On the second floor of the main building are the recording and mixing room, the machine room and the student equipment-training room — all of which are connected with each other and with the soundstage by sound-insulated plate glass windows and a telephone communication system.

The student equipment room, used to train beginners in the operation of the machinery, has a Stancil-Hoffman mixer, a recorder and a dummy playback unit. The advanced students use the other sound equipment as they participate in actual recording and re-recording of productions.

For the purpose of standardizing the sound equipment with the current practice of edge-track recording, Unusual Films added, in the summer of 1958, Stancil-Hoffman S7 equipment (Fig. 10) and converted all of its double-sprocketed center-track S4 and S5 recorders and dummy playbacks to single-sprocketed edge track. In order to use all of the large inventory of center-track film that had accumulated through the years, an interchangeable recording and playback head assembly was made for the S5 recorder, a task greatly simplified by the design of the Stancil-Hoffman machine. In the machine room, these recorders and playbacks, as well as a converted Bell & Howell incandescent and a Holmes arc projector, may be interlocked with a selsyn hookup incorporated on each machine. Any two or all of the machines may be interlocked and activated by one switch on the console. The workprint picture may be projected in interlock from the machine room to the recording room or the soundstage for viewing, for narration recording, for lip-sync or foreign language dubbing and for original music scoring. Incidentally, it is necessary to assemble a band shell for the proper recording acoustics when the entire University orchestra is used in scoring on the soundstage.

The Western Electric 639 and the Altec Cardioid microphones are used most frequently, though other types are on hand to be used as needed. The perambulator for the Mole-Richardson microphone boom was made in the studio machine shop. There are seven microphone outlets on the soundstage which terminate, as do all the controls of the sound system, on the modified Western Electric console in the re-recording room (Fig. 11). A single control switch simultaneously operates a bell for silence, turns on a network of warning lights and cuts off the air-conditioning motor for each take.

The University's radio station, WMUU, the student control room in the auditorium, and the auditorium radio-public address control booth employing Collins and RCA equipment may be patched into the console for special recording.

All input and output of recorders, dummies, amplifiers, projectors, busses, Altec compressor and Cinema Engineering Filter equalizer appear on the patch panel. All circuits within any one patch panel carry approximately the same signal level, thus helping to cut down crosstalk, which has been measured at about 80 db below signal level.

All the Stancil-Hoffman machinery has been modified to operate from a remote control panel. The forward-reverse switches have been replaced by relays, start-stop functions have been paralleled by relays, and the interlock selsyns are connected to the interlock bus by means of relays. Any machine can be changed from the interlock bus. If all the machines are conditioned, they may be put on or taken off the interlock bus as the operator desires. The panel also has controls to throw each machine into the motion bus with lights to indicate the operating condition of each machine. In keeping the audio equipment in optimum condition, a Hewlett Packard audio oscillator, a noise and distortion analyzer, a vacuum-tube voltmeter and a tube tester are used constantly.

The Editing Department

There are two editing rooms, complete with editing benches, six- and three-gang synchronizers, rewinds, Dazor lamps, Bell & Howell hot-splicers, Griswold splicers, sound readers and a Moviola. Every scene that is shot is logged and crossfiled under three different headings — subject, take number and edge number — as well as in the numerical order in which the cards were typed. The editing department has invented or fabricated several pieces of equipment:

(1) A tightwind for rewinding on cores.

(2) A sound reader which eliminates magnetizing film during editing. These sound readers have an Indiana Steel magnetic head embedded in a hand-carved piece of solid maple to which is wired a Stromberg-Carlson amplifier

which sits a few feet from the editing desk.

(3) The Bob Jones University Magnetic Sound Splicer has been designed and patented by Unusual Films. Using Minnesota Mining and Manufacturing tape No. 41, a diagonal butt splice can be made that requires no blooping. The sound splicer is designed so that one side of the machine is for cutting the film, and the other side is for registration, perforation and application of the No. 41 tape (Fig. 12). George Jensen, Chief Editor for Unusual Films, has noted that the splicer's advantages are that a single frame can be removed and restored, and that trims and waste material can be reclaimed and used repeatedly.

Future Prospects

The scope of Unusual Films production presents the problems of major studios without their unlimited facilities and resources. Therefore, it has been necessary to adapt and to create many of the tools and effects which have been needed. Among the new tools to be added soon is a dual-plane special-effects stand designed by the staff. It will be built on a 14-ft lathe bed, and it will be used for composite mattes and animation. The matte shots will combine live action with artwork or scale-model photography; they will be shot on a 35mm Acme camera and optically reduced to 16mm. Another item proposed is a 20-ft camera crane. A working scale model has already been approved.

The department also contemplates expanding the building which it occupies. This move has been necessitated by the growth of the Division of Cinema academically, and by the increased demand upon the distribution and production facilities of Unusual Films. Plans call for converting all existing offices and film storage areas into additional classrooms, editing rooms, etc. A new wing would house the executive, clerical and distribution offices; portrait studios; and a small projection and lecture auditorium.

The Training Unit

The Division of Cinema of the School of Fine Arts offers a Bachelor of Science, a Master of Arts, and a Master of Fine Arts degree. Any student in the University, regardless of his major, may choose Cinema courses as his electives. Furthermore, any student in the University may participate in the films or gain experience in the various aspects of production.

The requirements for the Bachelor of Science degree with a major in Cinema are thirty-six hours: Principles of Motion Picture Sound (6 hours); Camera I and II (6 hours); Film Editing I and II (6 hours); Cinema Seminar (6 hours); and six additional hours of electives in Cinema or related courses in Fine Arts.

In addition to these requirements, each Cinema major must fulfill the general requirements of all candidates for the Bachelor of Science degree which are selected to give the student a well-rounded academic background in such subjects as English, Foreign Language, History, Speech, Bible, Mathematics or Science, and Psychology.

The required Cinema curriculum gives the student basic technical knowledge in the various aspects of film making. The beginning course, Fundamentals of Motion Pictures, deals with nomenclature, vocabulary, and basic techniques of still and motion-picture photography.[1] During the freshman year, the student spends ten hours every week gaining working experience on the soundstage and in the still laboratory.

The still laboratory is operated on a professional basis; it serves not only the cinema department, but also the University proper and the faculty and student body individually. Students assist in preparation of all of the University's publicity photographs, yearbook pictures, portraits, etc. The equipment with which they work includes such items as a Linhof Kardan color 8 × 10 view camera, a Simmon Chromega D-4 Enlarger, and a Welch Densichron. All phases of Ektacolor and Ektachrome work and all types of black-and-white photography are handled, from exposure to finished print or transparency.

Principles of Motion Picture Sound covers electricity, sound magnetism, amplification, basic recording and re-recording methods, and the production of sound from actor to audience. Advanced courses deal with audio measurements, attenuators, mixers and transmission, and basic and advanced electrical theory.

Camera I and II give the student an opportunity to come into direct contact with the eyes of the film medium, for he learns to set up, operate and maintain the cameras, the electrical system and other production equipment. He also studies film characteristics, exposure theory, and the use of incident and integrating light meters.[2]

Advanced camera classes deal with additive and subtractive color processes, esthetics, color composition, geometrical optics and lens aberrations.

Film Editing deals with preserving continuity and a sense of direction, matching tones, crossing stage lines, and matching over-the-shoulder shots and the relationship of image size and angle.[3] In the advanced courses students practice cutting original A + B roll using both the checkerboard and the overlap method.

Cinema Seminar furnishes guidance to each senior on his creative project required for graduation, but emphasis is placed on the student's particular field of interest in Cinema.

Unusual Films endeavors to combine technical knowledge with creative and artistic ability. Whether the student specializes in directing, screen writing, production or set designing, editing, or one of the other crafts, every effort is made to develop the talent and abilities of each student and to set him in the right direction both technically and artistically.

A flying angel bearing a camera in its arms is the trademark of Unusual Films. Dr. Bob Jones, Jr., explains the trademark by saying, "The word 'angel' means messenger, and our films are films with a message."

Wine of Morning

The most ambitious undertaking of Unusual Films to date has been the production of *Wine of Morning*, a full-color, dramatic feature, nearly two hours in length. The religious "spectacular," produced entirely on the campus with a cast of students and faculty, was given a special showing at the Detroit Convention of the SMPTE in 1958. It also was chosen by the University Film Producers Association to represent the product of American colleges and universities at an International Congress of Cinema Schools held in Cannes and Paris in conjunction with the 1958 International Film Festival. Further honors include the first "sweep" of all four top awards of the National Evangelical Film Foundation.

The screenplay is based on the novel by Dr. Bob Jones, Jr. The story concerns the life of Barabbas, the man on whose cross Jesus Christ was crucified. The fanciful dramatization pictures Barabbas as a dedicated member of the Jewish, anti-Roman underground movement; he is

Fig. 12. Current production model of Bob Jones University magnetic sound film splicer.

depicted as a desperate, first-century "freedom fighter," who is disillusioned in his battle for political independence, but who finds spiritual freedom through the Man who died in his stead.

Among the many production challenges afforded by *Wine of Morning* was the Roman grain-ship sequence described elsewhere in this article. In all, 35 sets were erected on the soundstage, and nine other scenes required extensive exterior construction. The creation of costumes for the 75 speaking roles and 800 extras was a titanic undertaking in itself; these included everything from a high priest's robes to several full suits of Roman armor. Not least among the problems was the procurement of exotic livestock, such as camels and peacocks, to enhance the flavor of authenticity so necessary to the success of a film of this type.

Two years of research and pre-production planning, six months of sync-sound shooting, and seven additional months of editing went into the making of *Wine of Morning*. The result has been characterized by one reviewer as "the most spectacular achievement in the history of Christian films."

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Motion Picture Studio of Brigham Young University

By ROBERT W. STUM and R. IRWIN GOODMAN

After five years of research and planning, the new motion-picture studio for the Department of Motion Picture Production of the Brigham Young University began operation in the Fall of 1958. With the aim to produce pictures of highest quality at reasonable cost, for the University and the Church of Jesus Christ of Latter-day Saints (Morman) the studio was designed to carry an idea through from script to screen. The basic unit of this new facility is an 80 by 100-ft soundstage. Adequate space is provided for all activities relating to motion-picture production such as animation, art department, set construction, set storage, sound recording and dubbing. Included are separate offices for writers and production personnel. Modern equipment was selected for suitability and to meet the highest standards of perfection.

The Department of Motion Picture Production was established at the Brigham Young University, Provo, Utah, in 1953. It's aim was to produce pictures of highest quality, at reasonable cost, for the University and the Church of Jesus Christ of Latter-Day Saints. Under the direction of Wetzel O. Whitaker, formerly of Disney Studios, it's first productions were so successful that the demands for educational and religious films were greatly expanded. The campus studio was soon inadequate as the small stage made multiple sets out of the question, and, worse, outside noises coming through the paper-thin walls ruined thousands of feet of film. The new studio was therefore located in the middle of fifteen acres of pasture and woodland. This setting provides ample space to develop good exterior sets and locations within reach of the studio's own power supply (Fig. 1). Multitudes of possibilities are offered by the site, which includes two pastures separated by a row of trees and five acres of untouched woodland with it's own stream of water. And, unlike the old studio on the University campus, it is quiet! After five years of planning and many consultations with friends in the motion-picture industry, the architect, Bruce R. Dixon, drew up final plans and construction was started in April, 1958. The first step was the pouring of the soundstage floor.

The entire studio, in operation since the Fall of 1958, covers an area of 13,160 sq ft, the major portion of which is taken up by the 80 by 100-ft soundstage (Fig. 2). The remainder is divided between an office wing on the north side of the stage and a spacious storage area along the west end. The exterior walls of the stage are of cement finish, and those of the office and storage areas are faced with vertical steel panels and cast stone. Glass has been extensively used in the two-story office and technical wing, admitting the soft north light (Fig. 3).

Entrance to the studio is through a full two-story glass-front lobby and reception room (Fig. 4). At the left of the lobby are the production offices, camera storage room and shop, animation camera room, darkroom, make-up room, rest rooms and dressing rooms. Access to the second floor is by a free-standing, cast stone and steel staircase. On the second floor are offices for writers and artists, and rooms for editing, viewing, projection, sound control, and narration and music. Downstairs to the right of the lobby is the echo chamber, film vault, furnace and fan rooms and storage area.

Office Wing

The outside wall of the office wing consists of precast stone panels bolted onto the prefabricated steel frame along with the window casings (Fig. 5). The first room to the left of the ground-floor lobby is the production office. Two of the interior walls are exposed concrete block. The wall dividing the main production office from the adjoining producer's room consists of red-oak cabinet work, which equips each room with a built-in bookcase and closet. This type of bookcase-closet divider is also used between the two other offices on the first floor and the two writer's offices upstairs. In the event of expansion, the cabinetwork can easily be removed and the two rooms combined. The ceilings are random-perforated, acoustical tile.

The producer's office accommodates a large conference table as well as his desk. The walls are equipped with picture rails for story boards used in production meetings and conferences with clients. Next down the hall are two smaller offices, the first occupied by a production assistant and the second by the art director. At the end of the hall is the camera shop. Furnished with work counters running along two walls, this room is used for equipment maintenance and storage and is also used by the sound engineer for the building and maintenance of sound gear. This room

Presented on October 21, 1958, at the Society's Convention in Detroit, Mich., by John Flory, Eastman Kodak Co., Rochester, N.Y., for the authors, Robert W. Stum and R. Irwin Goodman, Dept. of Motion Picture Production, Brigham Young University, Provo, Utah.
(This paper was first received on October 20, 1958, and in complete form on March 2, 1961.)

is located adjacent to an exterior door to facilitate the loading of equipment into vehicles for location production.

Across the hall from the camera shop is the animation camera room housing a 16mm Acme Animation Crane. Tables are provided on two sides for laying out animation cels. Next down the hall is a fully equipped darkroom for the processing and printing of production and publicity stills, for production of slide film photo-art and for loading motion-picture film. Located next to the darkroom is the make-up room, equipped with mirrors along one wall, storage space for make-up supplies and a professional beautician's chair. Two dressing rooms with mirrors and large clothes racks complete the first floor of the office wing. In conjunction with these dressing rooms are the restroom facilities plus a shower on the men's side for the use of the staff.

Sound Lock

To provide quick access to the soundstage and keep the cast from wandering into unauthorized areas, the soundlock access to the stage is located between the make-up and women's dressing rooms. The lock is also only a few steps from the production offices. Each of the two doors has a sound reduction of at least 30 db over a range of 129–2070 cps. A red warning light is visible above the door, on each side of the sound lock.

Second Floor of Office Wing

Upstairs, (Fig. 6) directly over the production office, are two rooms for writers. Adjoining these offices is a spacious art and animation room, equipped with an animator's desk, animation checking desk, ink and paint tables, drafting tables and sink for mixing paints. Two editing rooms complete the north side of the second floor. Across the hall is a small theater equipped with 20 seats and space for a dubbing console. The 4 by 10-ft screen accommodates either normal or wide-screen format. Masks and drapes are adjusted to cover the areas not in use.

Sound Control Area

The next area could be called the "sound control core," the center being the sound control room with a mixing console facing a large double-glazed window looking onto the stage (Fig. 7). The console is an Emcor Modular Enclosure with a Stancil-Hoffman AM-7 six-channel transistor mixer, speech and program equalizers and the usual remote switching equipment. To the left of this room is the projection booth with one port into the theater and another double-glazed port opening onto the soundstage. A screen can be lowered on the far side of the soundstage to accommodate audiences for special screenings, as an alternate to using the theater. For some dubbing sessions, the sync-locked projector can project from this same port onto a screen hung approximately 15 ft out onto the stage which can be viewed from the control room. To the right of the sound control room separated by another set of double-glazed windows, is the narration and music room with two plastered walls and two draped walls, giving an

Fig. 1. Aerial view of Brigham Young University soundstage with parking area and woods on the left. Pasture on the right is available for expansion.

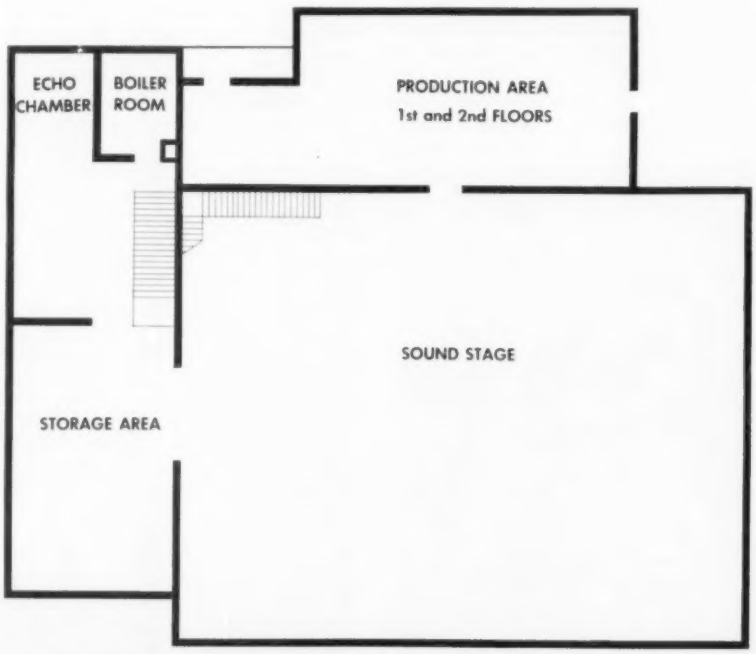

Fig. 2. Composite floor plan showing relation of primary areas.

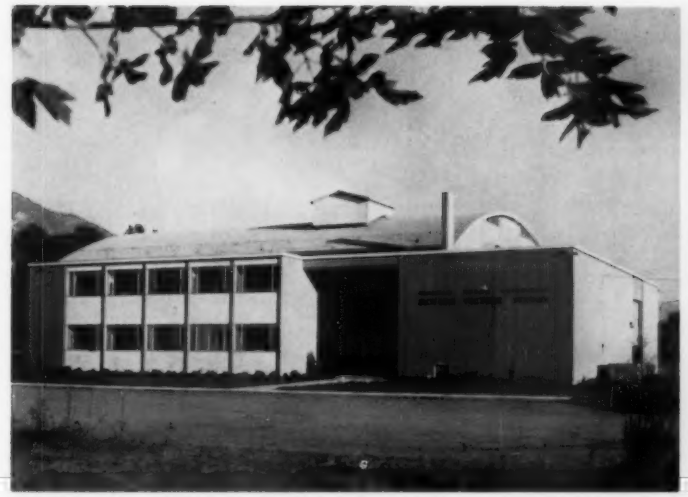

Fig. 3. Exterior view of office wing and storage area with soundstage immediately behind.

Fig. 4. Main entrance to offices and soundstages.

opportunity to vary the amount of reverberation for narration and music pickups.

The fourth wall of the sound control room provides another window behind which are located two Stancil-Hoffman S-7 recorders and two D-5 dubbers.

Considerable attention was paid to making certain that ample conduits were provided to reach out from the sound control room to all necessary areas, including the stage.

By necessity, each man is called on to serve in several capacities; hence, one man acts as both mixer and recordist. The large window in the sound control room overlooking the stage permits the sound engineer to operate from there and still observe most of the stage activity. He maintains communication with the mike boom operator by intercom.

Storage Area

The storage area is made of timber framing covered with vertical steel panels and has an area of over 2200 sq ft. A loft covering half of this area is used for prop storage. Below the loft is the carpenter shop and lumber storage section. Access to the outside is through a roll-up motor-operated steel door.

Echo Chamber

In the corner of the storage area and stucturally isolated from the rest of the studio, is the echo chamber. This reinforced-concrete room with two solid core doors has a volume of approximately 2440 cu ft and is designed with nonparallel walls, floor and ceiling to prevent resonant peaks at any frequency. Walls and ceiling are smoothed to a hard, polished surface with a cement-plaster combination. Several conduits connect this room to the sound control core.

Convenient to the offices is a film vault constructed of reinforced concrete, equipped with a 3-hr fire door, and furnished with the usual metal film-storage racks.

Soundstage

Entrance to the stage is through a 14 by 16-ft refrigerator-type door. The active leaf of these double doors

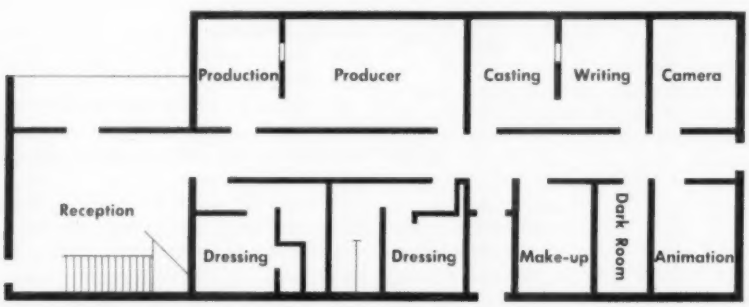

Fig. 5. First floor, office wing.

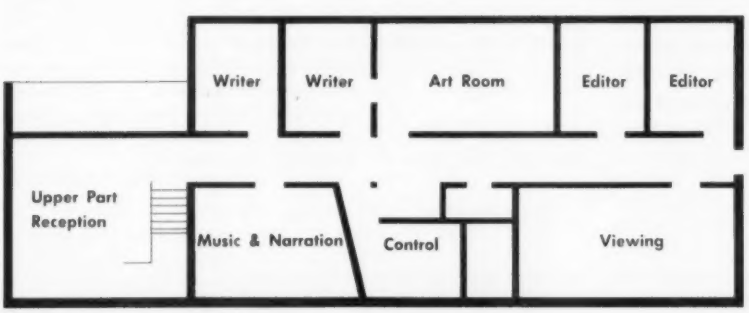

Fig. 6. Second floor, office wing.

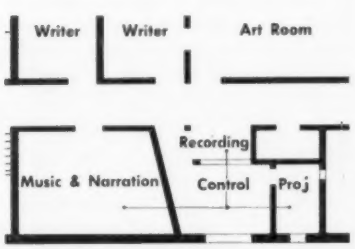

Fig. 7. Second floor; office wing showing "sound control core" centrally located between narration room, projection room, recorders and stage.

is equipped with a panic release for instantaneous opening. The doors have a density of 17.2 psf and an average sound reduction greater than 50 db over a range of 120–2070 cps.

The soundstage is 80 ft wide by 100 ft long and is 24 ft from the floor to the grid (Fig. 8). The structure of this building consists of a 5-in. concrete floor with 6-in. tilt-up concrete panels for the exterior walls. Next to this concrete wall is a separate isolated frame wall covered with rigid glass-fiber panels $1\frac{1}{2}$ in. thick. The glass-fiber panel is of 9-lb density Industrial Building Board with a white Neoprene painted surface that protects the material and greatly increases the light reflectivity. Condensation within the walls is controlled by additional glass-fiber batts backed with a vapor barrier sealed within this second wall. The walls of the stage have an average sound transmission loss greater than 56 db. The glass-fiber panels not only contribute to the sound transmission loss but also provide good sound absorption. The calculated reverberation time will vary from 0.95 at 125 cps to less than 0.4 above 2000 cps.

To prevent external noises from being transmitted to the stage, extreme care was taken to provide complete physical isolation of the soundstage structure from the rest of the building. Rigid inspection during construction was carried out to make sure that there was no mechanical contact between the office wing, storage area and soundstage. Openings between the walls and floors adjacent to the soundstage wall are sealed with a flexible calking compound. The roof framing consists of four bowstring trusses at 20 ft on center, supporting 2 by 12-in. wooden roof joists. Two layers of $\frac{1}{2}$-in. plywood are covered with a built-up roof. Glass-fiber batts backed with a vapor barrier are sealed between the joists. A $\frac{1}{2}$-in. gypsum board layer is attached to the underside of the joists. The ceiling is finished with rigid glass-fiber panels $1\frac{1}{4}$-in. thick. The average sound transmission loss through the roof is about 40 db.

The ventilation of the soundstage is accomplished by means of an exhaust system using two 5-ft fans in the roof. The air is blown out through a sound trap, located on the roof, made of baffles lined with glass-fiber. Fresh air is brought in through a grill located high in the exterior concrete wall. The air passes down through a duct lined with glass-fiber to a grill located in the interior frame wall near the floor. These air intake ducts are 31 ft long and provide a sound attenuation of approximately 60 db at 512 cps. Compressed air, gas and water are available at one corner of the soundstage for set construction and for other uses on the set.

Fig. 8. View of soundstage toward doors leading to storage area.

Catwalk System

Attached perpendicularly between the bottom cords of the wood trusses are 4 by 12's at 4 ft on center. These wood grid members support the upper catwalks and also provide support for the light parallels suspended below. This part of the catwalk system is very similar to those in the Hollywood soundstages, i.e., lower catwalks or parallels suspended with chain and hangers from a grid system near the ceiling. These lower movable catwalks are placed and serviced from permanent catwalks located on the grid above. One of the unusual things about this soundstage is a semipermanent lower catwalk around the entire perimeter of the room at a height to accommodate a standard 10-ft set. The majority of the production centers around the use of 10-ft flats, and the use of a semipermanent lower catwalk saves a considerable amount of set-up time.

Lighting Power

The soundstage is supplied with alternating current through 6-in. fiberducts to four 600-amp breakers located at different points along the 100-ft walls of the stage, all 6 ft from the floor rather than high in the upper catwalks. Fiberduct is used in place of metal conduits to eliminate the a-c hum. A spare fiberduct has been provided from the transformer vault to the stage for future expansion.

Considerable feeder cable is saved by running power from the breakers up to remote switchboards located on the lower perimeter catwalk rather than the usual method of dropping from breakers high in the rafters. This is also very practical as a labor-saving device. Small sets can easily be rigged from the nearest breaker and manually operated from the floor.

Outside d-c power is brought in from two portable 150-amp motor generators through a 6-in. port in one wall of the stage.

The five years of planning for the best possible facilities had as its long-range goal the unhampered development of individual creative abilities. The obsolete studio and inadequate stage are now things of the past and with its new facilities, the Department of Motion Picture Production of Brigham Young University can look forward to a bright future.

Physical and Technical Parameters of Flashtubes

By I. S. MARSHAK
and L. I. SHCHOUKIN

Studies were made of flashtubes with a limited discharge column (capillary tubes); and with an unlimited discharge (lamps with spherical bulbs), in a minimum inductance circuit. The investigations included extreme cases of the construction and supply parameters. Discharge characteristics in capillaries are similar to those in wide-diameter tubes, though corresponding values of specific resistance occur at electric fields some 5 to 10 times higher.

The specific resistance of plasma becomes almost constant (equalling ~ 0.02 ohm cm) at $E \gtrsim 120$ v/cm. The discharge extinction voltage is approximately inversely proportional to the inner diameter of the tube. The increase of the light efficiency stops at $E \cong 400$ v/cm (reaching very high values of about 40 lm/w). The dependence of the flash duration τ on construction data and on supply parameters was determined, over a wide range of conditions. Within narrow limits of parameter modifications the following expression may be used: $\tau = AU_0^{-0.6}(Cl)^p d^{-q}$

Here A is the proportionality coefficient; U_0, the initial voltage on the supply condenser; C, the condenser capacity; l and d, the length and the inner diameter of the tube; p and q, approximately constant exponents, which change respectively from 0.5 to 1 and from 0.5 to 2, for wide variation of the parameters. The influence of the inherent discharge circuit inductance on the luminous characteristics of tubular lamps is almost insignificant. The working temperatures of quartz *and* glass *tubular lamps, which are on long-duration stroboscopic duty (750C and 250C respectively) are attained at mean powers of about 10 and 1.8 w/cm of tube length, respectively. The tubes perform for a few seconds (without forced cooling) at powers of 40 and 4 w/cm, respectively.*

The load factor, $(CU^4)_{max}$, which determines load limits in single-flash operation conditions, does not depend on the diameter, d, for glass *tubes in the range from 0.5 to 11 mm, and for* quartz *tubes in the range from 0.5 to 2 mm. The time necessary for the deionization of the gas gap in capillary quartz tubes, dissipating ~ 2 w/cm increases from 80 to 270 μsec for an increase of the initial electric field from 140 to 280 v/cm. At higher power the deionization period drops from 500 to 300 μsec. Accordingly, the critical flash frequencies of such tubes (without any additional commutation element in the discharge circuit) are equal to 12 kc/sec at low wattages, and of about 3 kc/sec at higher wattages.*

To investigate extreme discharge performances in tubes with spherical bulbs, various low-inductance condensers and tube designs were tried. These included disc-shaped, pot, and cylindrical ceramic condensers; cylindrical and spherical quartz condensers; cylindrical film condensers; disc-shaped and coaxial lead-ins, connections and electrodes. As a result data were obtained for discharge circuits of the minimum possible inductance. Investigations were made of discharge column expansion velocities, and of discharge characteristics for various supply parameters. Construction data and supply parameters for tubes with a flash duration of 0.1 μsec, a flash frequency of 3 kc/sec, and a power of 1 kw were established.

Introduction

A series of reports on the physical and technical characteristics of flashtubes has been published earlier.[1-9] In the present series of experiments studies have been made of extreme cases of flashtube construction and of the supply parameters.

The study has included tubes with a very limited discharge channel, such as capillary tubes, which are of special interest for Töpler photography, and tubes with an unlimited discharge column, e.g., lamps with spherical bulbs and short spark gaps producing flashes with a maximum brilliance, a minimum duration and an extremely small luminous volume. In the latter case special attention was paid to the reaching of a maximum speed in the delivery of energy into the discharge column by the utmost reduction of the inductance in the discharge circuit.

Tubular Flashlamps

The study of discharges in capillary tubes included quartz and glass lamps with an inner diameter of the tube, $d = 0.2$ to 1.1 mm; and length (not taking into account the widened parts at the electrodes), $l = 10$ to 100 mm. The tubes were filled with xenon, krypton and argon to a pressure $p = 50$ to 920 mm of mercury. The supply condensers were of capacity C from 0.05 μf up to a few dozen microfarads, charged to a voltage U from a few hundred volts to a few kv. When the tubes were used as strobotrons, a current interruption in the condenser charging circuit, necessary for gas deionization, was secured in order to prevent the transition of the discharge to a stationary operating condition.

In Table I supply parameters are shown which are necessary in order that the discharge columns may fill the particular capillary tubes (xenon, $p = 600$ mm of mercury, $l = 70$ mm). These data were obtained by photographing single discharges in the capillary tubes. For equal flash energies, discharges with greater voltages and lesser capacities fill the capillary tubes less satisfactorily.

The data of Table I agree with oscillographic investigations, which show a coincidence of positive slope branches in the voltage-current characteristics for discharges which fill the capillaries.[4]

In Fig. 1, curves are given of the plasma discharge specific resistance ρ as a function of the electric field strength E, for capillary tubes and for wide tubular lamps of different diameters.[4] Figure 1 shows that the

Presented as an abstract at the Fifth International Congress on High-Speed Photography in Washington, D.C., by Dr. A. I. Tchernyi for the authors, I. S. Marshak and L. I. Shchoukin, Laboratory of Flashlight Sources at the Electric Lamp Works, Radiotechnical Industry Ministry, Moscow, USSR.

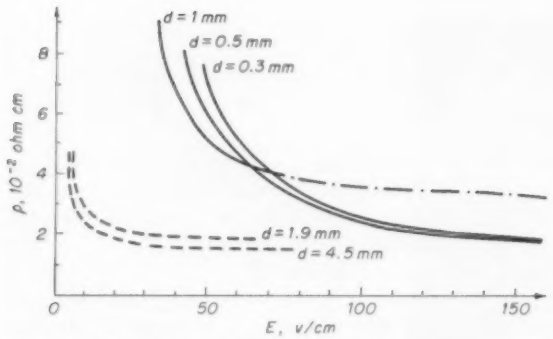

Fig. 1. The dependence of the plasma specific resistance on the electric field strength for three diameters of capillary tubes (full lines, xenon, p = 600 mm of mercury, l = 70 mm, C up to 0.5μf, U up to 1.5 kv). The chain dashes show the region of the somewhat increased ρ-values for d = 1 mm, because the capillary tube is not entirely filled. The dotted lines are for wide tubular lamps.[4]

electrical characteristics of the discharge in capillary tubes are similar to those which were obtained for large bore tubular lamps, with the exception that the specific resistance begins to rise noticeably at electric field strengths which are three or four times greater. For practical estimates an approximate value ρ = 0.02 ohm cm at field strengths > 100 v/cm may be used. At E > 100 v/cm ρ for xenon is 10 to 20% greater than for argon. A decrease in gas pressure from 600 to 100 mm of mercury lowers ρ by 30 to 50%.

The discharge extinction voltage, as expected,[2] increases rapidly with a fall in d and a rise in p and l (see Fig. 2). The ignition voltage depends but slightly on the diameter of capillary tubes, and on the form and position of the exterior igniting electrode. It is directly proportional to the length of the capillary tube, and to the square root of pressure. It is inversely proportional to the ignition pulse value (Fig. 3). The spontaneous breakdown voltage, which has a large scatter (especially when the igniting electrode is not attached to the tube), exceeds the controlled ignition voltage by 5 to 15 times for a possible breakdown; and by 10 to 30 times for a certain breakdown. Without the igniting electrode the spontaneous breakdown voltage is from 1.5 to 2 times greater still.

Table I.

d, mm	C, μf	U, kv	$\frac{1}{2}CU^2$ j
1	0.5	1.5	0.56
0.5	0.1	1.5	0.11
0.3	0.025	0.8	0.008

The product of the peak candle-power $\mathcal{J}_a$ and the flash duration τ, measured at a 35% peak amplitude level, for capillary tubes and for wide tubular lamps is equal to the candle seconds integral $\int \mathcal{J} dt$ divided by a coefficient K = 0.86 ± 0.02, constant for all tubes and supply parameters. The peak candle-power and flash duration τ are roughly proportional to the atomic number of the inert gas. See for instance Table II, which shows tube characteristics with d = 0.5 mm, l = 70 mm, p = 600 mm of mercury, C = 0.25 μf, U = 1.2 kv.

$\mathcal{J}_a$ reaches its maximum at a pressure of 100 mm of mercury, then it decreases somewhat with the increase of p, and at ≳ 500 mm of mercury no longer depends on p

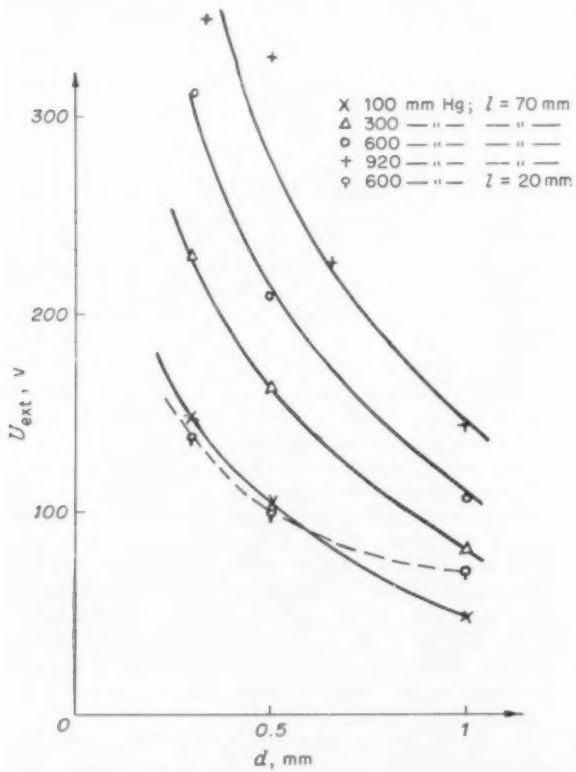

Fig. 2. An example of discharge extinction voltage dependence on diameter, gas pressure and tube length for a xenon filling.

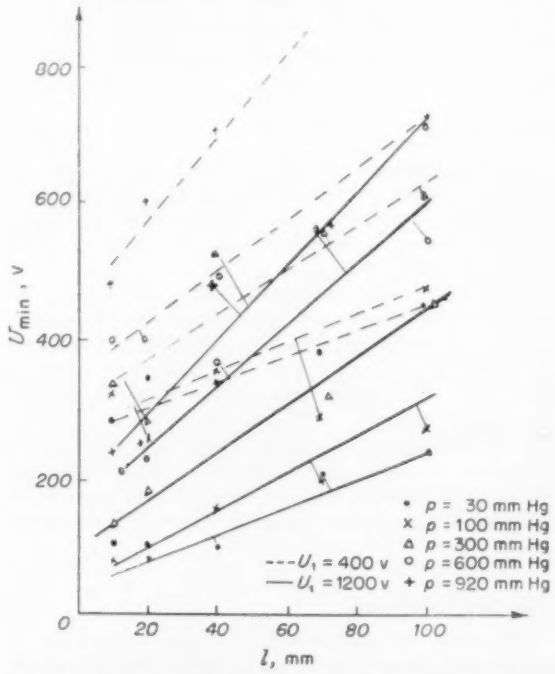

Fig. 3. An example of discharge igniting voltage dependence on tube length, gas pressure and voltage U_1 on the primary winding of the igniting pulse transformer, for a xenon filling and for d = 0.5 mm.

Table II.

Gas	τ μsec	ϑ_a, cd	$\int \vartheta dt$, cd sec
Xenon.....	21.4 ± 1.1	7900 ± 280	0.15
Krypton.....	19.4 ± 1.8	5100 ± 280	0.082
Argon.....	12.6 ± 0.4	2200 ± 260	0.024

(Fig. 4). The flash duration increases with p up to 500 mm of mercury and then also attains constancy. $\int \vartheta dt$ gradually increases with p up to 300 mm of mercury, and thereafter does not depend on p. The peak candle-power ncreases linearly with increase of the capillary tube diameter d; and $\int \vartheta dt$ increases rapidly up to $d = 0.5$ mm, and then rises more slowly (Fig. 5).

The length of the *capillary* influences the light output in tubes shorter than 70 mm. The total potential drop between the electrodes (including the potential drops in the expanded tubulations close to the electrodes), determined by comparing the light output for various values of l,[8] is equal to 150 v. This value is roughly three times greater than the value for *wide* tubular lamps.

With a longitudinal electric field strength <250 v/cm the light output efficiency η rapidly increases with the increase in voltage; but at $E \gtrsim 400$ v/cm it reaches the maximum value of 3.2 candle seconds per joule (cd sec/j) (Fig. 6). An increase in the supply condenser capacity leads to an increase in the light output efficiency η up to $C \cong 1$ μf (Fig. 7). The capillary tube light output values, obtained at great electric field strengths, exceed the light output values of lamps with spherical bulbs. Thus capillary tubes may with advantage be widely used in high-speed photography.

The inductance of the discharge circuit, if it does not exceed 100 μh, does not significantly influence the light output characteristics of the tubes. However, if the inductance increases to 2500 μh, the flash duration is doubled, the integrated light output decreases 30%, and accordingly the peak candle-power decreases three times.

We can draw a nomographic chart based on the ample

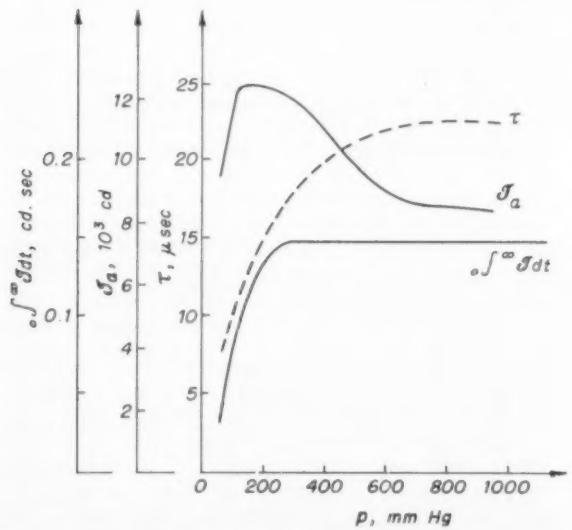

Fig. 4. An example of the dependence of peak candle-power, ϑ_a, intensity-time integral $\int \vartheta_{dt}$, and flash duration τ on xenon pressure ($d = 0.5$ mm, $l = 70$ mm, $C = 0.25$ μf $U = 1.2$ kv).

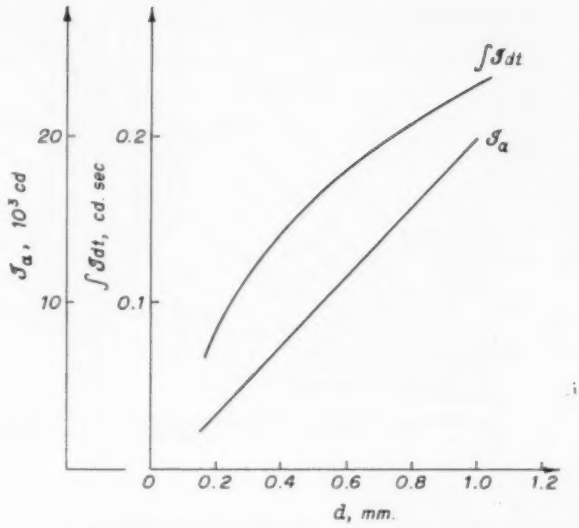

Fig. 5. The dependence of peak candle-power ϑ_a, and intensity time intergral $\int \vartheta_{dt}$ on the tube diameter (xenon, p = 600 mm of mercury, $l = 70$ mm, $C = 0.25$ μf, $U = 1.2$ kv).

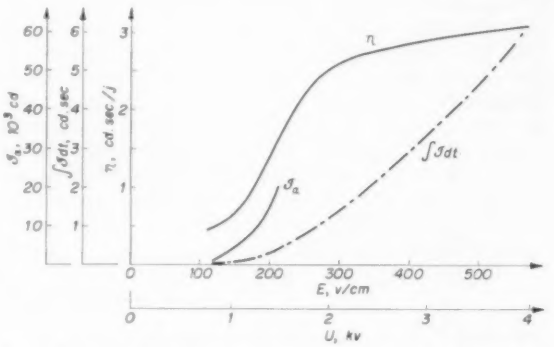

Fig. 6. The dependence of peak candle-power ϑ_a, intensity-time integral $\int \vartheta_{dt}$ and light output efficiency η on E (xenon, $p = 600$ mm of mercury, $d = 0.5$ mm, $l = 70$ mm, $C = 0.25$ μf).

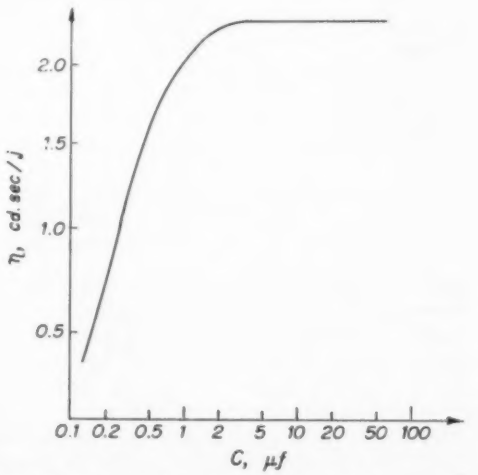

Fig. 7. The variation of light output efficiency η with C ($U = 1.2$ kv; other parameters as for Fig. 6).

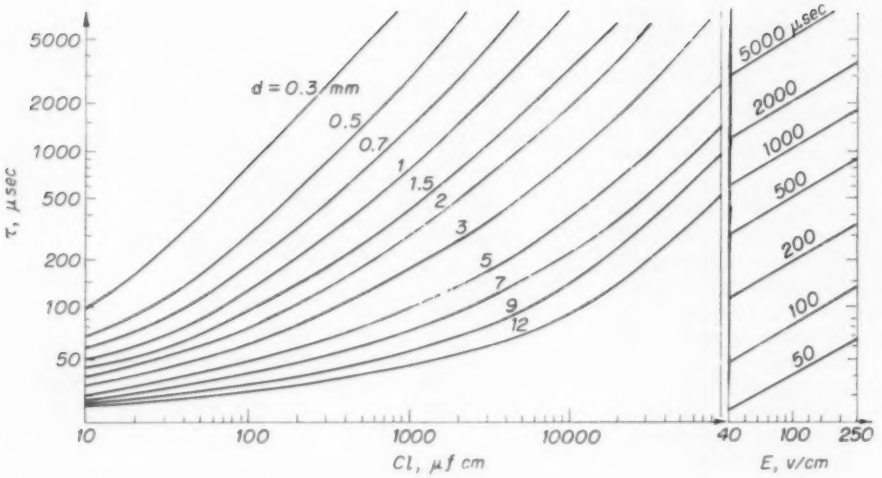

Fig. 8. On the left the curves show the dependence of τ on Cl with different values of d, and the initial electric field strength E_0 = 100 v/cm. On the right is the displacement of the ordinate scale with a change in the initial electric field strength.

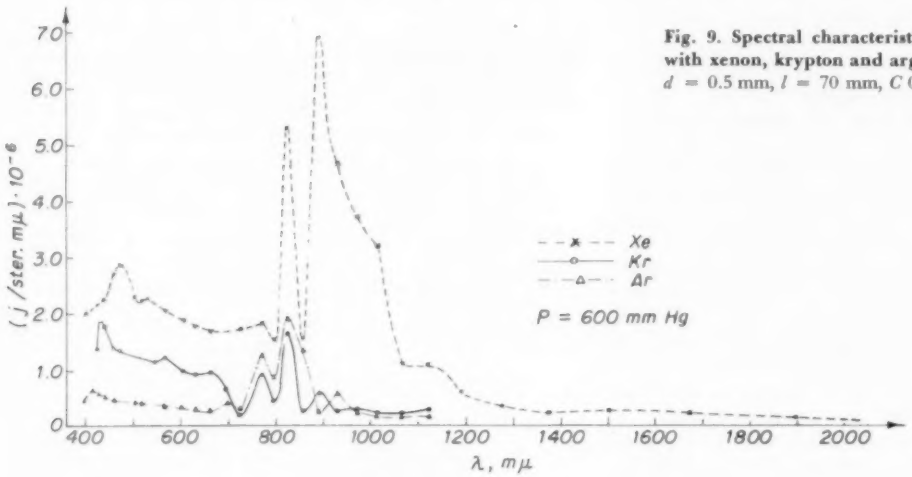

Fig. 9. Spectral characteristics of capillary tubes filled with xenon, krypton and argon (p = 600 mm of mercury, d = 0.5 mm, l = 70 mm, C 0.25 μf, U = 1.2 kv).

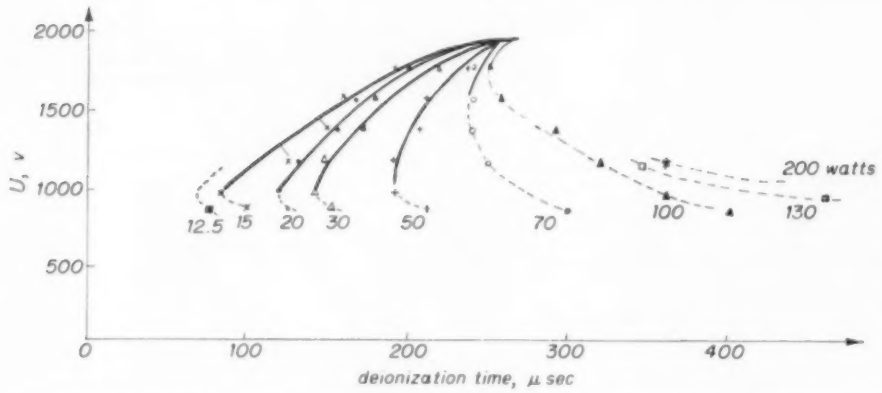

Fig. 10. Deionization time curves for capillary tubes (quartz, d = 0.5 mm, l = 70 mm, xenon, p = 600 mm of mercury) with wattage dissipation from 12.5 to 200 w. The dotted line branches are the regions of t erroneously increased by the discharge duration time.

experimental material for capillary tube lamps and wide tubular lamps, concerning the dependence of flash durations τ (measured at 35% of the maximum intensity) on d, C, l and E. From this chart, which is shown in Fig. 8, it it possible to determine τ for a wide range of different conditions. It may be observed that within narrow limits of parameter variations it is possible to consider the curvilinear diagram as a straight one, and thus use a formula similar to the one already mentioned by other authors.[10]:

$$\tau = AU_0^{-0.5}(Cl)^p d^{-q} \qquad (1)$$

Here A is the proportionality coefficient; U_0 is the initial voltage of the supply condenser; p and q are approximately constant exponents. (At $\tau \gtrsim 50$ μsec p and q are roughly equal to 0.5. At $\tau \gtrsim 500$ μsec, $p = 1$, $q \cong 2$. These values are consistent with the proportionality between τ and the time constant RC of the discharge circuit; where R is the tube resistance computed by the formula $R = \rho l \Big/ \left(\frac{\pi d^2}{4}\right)$.

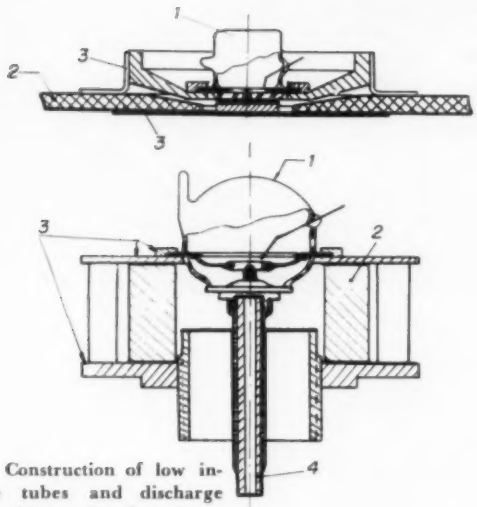

Fig. 11. Construction of low inductance tubes and discharge circuits with a disc-shaped ceramic condenser: 1 — tube; 2 — condenser; 3 — kovar disc; 4 — ballast resistance.

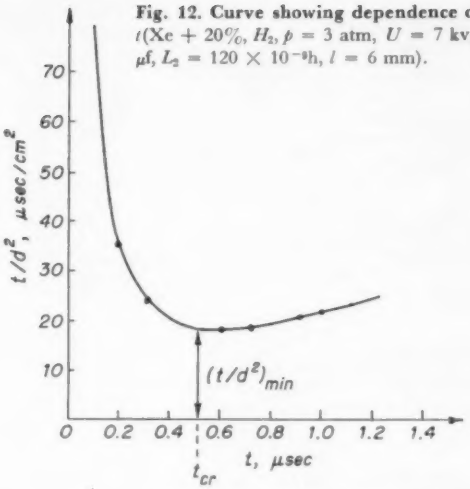

Fig. 12. Curve showing dependence of t/d^2 on t(Xe + 20%, H_2, p = 3 atm, U = 7 kv, C = 0.1 μf, L_2 = 120 × 10^{-9}h, l = 6 mm).

The spectral characteristics of capillary tube lamps filled with various gases are shown in Fig. 9. These characteristics were obtained by M. I. Epstein, who operated with a wide monochromator outlet slit, and used envelope plotting after plotting the spectrum in blocks.[9] These characteristics differ but little from the characteristics of wide tubular lamps. A modification in gas pressure (from 100 to 600 mm) and in the lamp supply conditions (C from 0.25 to 0.5 μf, U from 0.8 to 1.2 kv) does not significantly influence spectral characteristics. (This generalization does not take into account a 30% intensity increase in the 900- to 1200-mμ region, when the operating voltage decreases from 1.2 to 0.8 kv.)

In stroboscopic operations the wattage permissible for *quartz* and *glass* capillary tubes is respectively 10 and 1.7 w/cm of the tube length. For short-time operations the wattage may be increased 2 to 2.5 times.

In single-flash operation the maximum loads do not differ from the corresponding loads for wide tubular lamps with equal values of $C\,l$. In this regime the dependence of the load-limit on capacity and voltage is characterized by a constancy of the load factor $(CU^4)_{max}$.[2,4,6] Thus, the regularities already revealed may be applied to tubes with inner diameters ranging from 0.5 to 15 mm.

The time lags between the igniting pulse and the beginning of the flash are of a stable nature. The scatter does not exceed 0.1 μsec. For l = 70 mm, and for variations of the operating voltage U_0 within the limits of 0.8 to 1.2 kv, and the voltage U_1 on the primary of the igniting transformer of 0.8 to 1.35 kv, the time lags are within the range of 4 to 18 μsec, and decrease approximately linearly with increase of U_0 in the abovementioned range. In Fig. 10 curves are given of the gas deionization time for capillary tubes. The deionization time was determined as the reciprocal of the maximum flash frequency at a given supply voltage, and with the condenser charging time equal to the duration of its discharge through the tube. (For the rest of the cycle the voltage on the tube was equal to the discharge extinction voltage.) If great wattages are dissipated in the tube at low supply voltages, the discharge duration is comparable with the deionization time. The diagram thus shows dotted line branches, which correspond to the erroneous increase in the apparent deionization time when operating voltages are low. The true deionization time (solid lines) substantially decreases with the decrease in the dissipated wattage, at high supply voltages. From Fig. 10 it can be seen that at 15 w and an operating voltage of 1 kv, these tubes may be used, without any additional commutating device in the discharge circuit, at a flash frequency up to 12 kc/sec (assuming "momentary" charging of the condenser prior to the flash). An increase in the average power up to 70 w necessitates a decrease in the maximum flash frequency to 4 kc/sec. At this power it is advisable to select the higher operational voltage (about 1.8 kv) in order to reduce the discharge duration and to provide a greater interval for the gas deionization.

Short Gap Flashlamps

The study of discharges with a short unlimited column, was conducted on lamps which were similar to the commercial tubes ИСШ 100 and ИСШ 500, and also on tubes with a minimum inductance of the current lead-ins which were constructed in the form of two parallel kovar discs sealed into the glass as shown in Fig. 11. The tubes were filled with xenon or argon, either pure or with an admixture of hydrogen, at a pressure of a few atmospheres. Various low-inductance condensers were used. They were coupled to the tubes by low-inductance elements. The study included disc shaped, cylindrical, and pot shaped ceramic condensers, cylindrical and spherical quartz condensers, and cylindrical film condensers.

The oscillographic studies of various discharge circuits showed that the minimum inductance L attained was 5 to 6 × 10^{-9}h (for cylindrical film and ceramic disc condensers). The inductance of certain circuit elements, including the discharge column, may be computed by the usual formulas. For instance, a column 5 mm long and 0.3 mm in diameter has an inductance of 3.3 × 10^{-9}h. Parallel connection of cylindrical condensers by coaxial contact cylinders, and the connection of a tube with a condenser by a low-inductance cable of a rectangular cross-section, increases the inductance of the circuit by 10 to 20 × 10^{-9}h.

A study was made of the discharge column expansion with low values of L using a high-speed raster camera

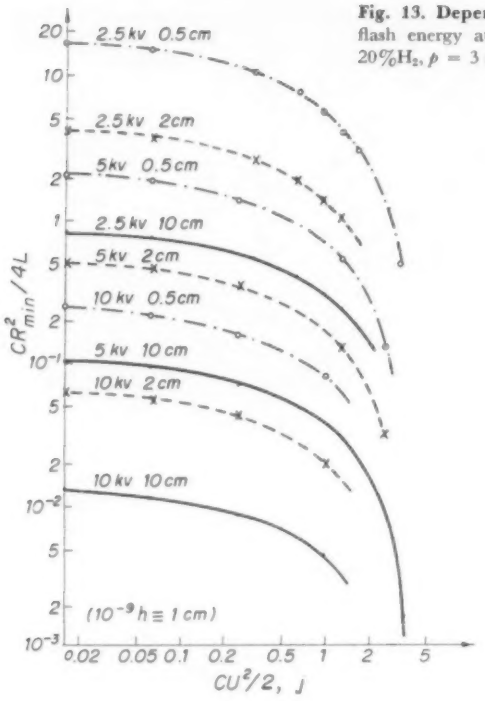

Fig. 13. Dependence of the value of $CR^2_{min}/4L$ on flash energy at various values of U_2 and L (Xe + 20%H_2, p = 3 atm, l = 6 mm).

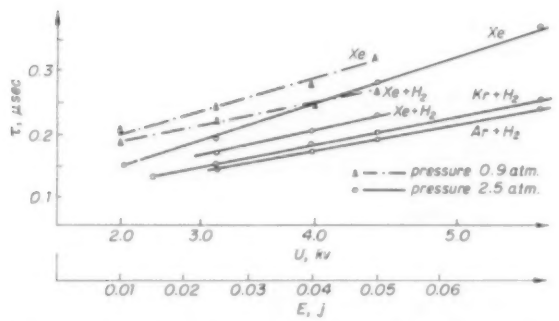

Fig. 14. An example showing the dependence of τ on the square of the voltage (C = 0.005 μf, l = 6 mm, $L = 10 \times 10^{-9}$h).

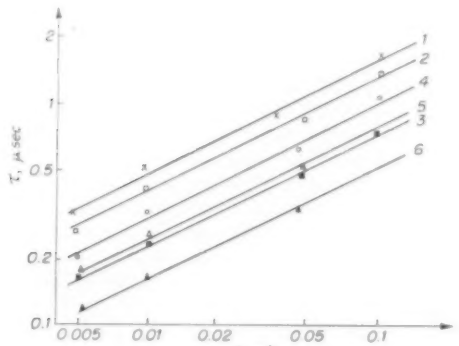

Fig. 15. An example showing the dependence of τ on C (l = 6 mm, p = 2.5 atm).

	Gas	U/kv	l/cm
1	Xe + H_2	4	150
2	Xe	4	10
3	Xe	2.45	10
4	Xe + H_2	4	10
5	A + H_2	4	10
6	A + H_2	2.45	10

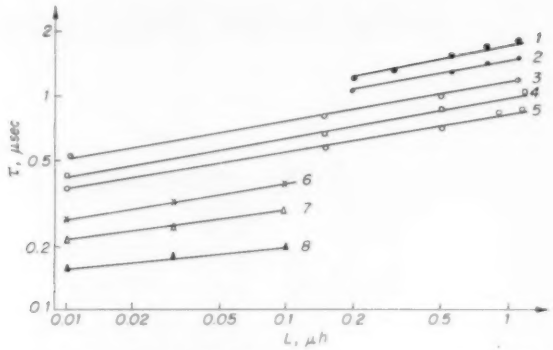

Fig. 16. An example showing the dependence of τ on L (l = 6 mm, p = 2.5 atm).

	Gas	C/μf	CU^2/2
1	Xe	0.1	0.2
2	Xe	0.01	0.2
3	Xe + H_2	0.01	0.2
4	A + H_2	0.01	0.2
5	Xe + H_2	0.01	0.1
6	Xe + H_2	0.005	0.08
7	Xe + H_2	0.005	0.05
8	Xe + H_2	0.005	0.02

made by the Leningrad Institute of Cinema Engineers.[11] The study showed that the expansion picture agreed with the data of other authors obtained with greater values of L. The initial speed of V_0 of the growth of the channel radius does not depend on C, but changes with U and L in accord with the formula:

$$V_0 = B\sqrt{U}\log\left(\frac{9\times 10^4}{L^2/_3}\right) \qquad (2)$$

where U is in kv, L in 10^{-9}h, V_0 in mm/μsec, B for Xe + 20% H_2 is equal to 0.37, for Kr + 20% H_2 = 0.4, for Ar + 20% H_2 = 0.45.

Besides the values of V_0, the expansion process is characterized by the value $(t/d^2)_{min}$ which may be attached to the tempo of the channel expansion as a whole. See Fig. 12 which shows a curve of t/d^2 versus time. Empirical equations connecting $(t/d^2)_{min}$ and corresponding values t_{cr}, d_{cr} as well as d_{max} with discharge parameters take the following form (Xe + 20% H_2, p = 3 atm, l = 5 mm):

$$(t/d^2)_{min} = \frac{30}{\sqrt{1/_2 CU^2}} + 0.12\,(L - 120) \qquad (3)$$

$$t_{cr} = 2.45 + 0.007\,CU(L - 120) \qquad (4)$$

$$d_{cr} = 0.24\sqrt{CU}\ (5);\quad d_{max} = 1.22\,d_{cr} \qquad (5a)$$

An oscillographic study of the electric pulse for various discharge parameters has shown that the effective resistance of the column (measured by the damping of oscillations) changes with the column diameter d and the electric field strength just as if the column were a homogenous conducting cylinder with a specific resistance ρ, the same value as was found for the discharge in the tubular lamps (with an equal electric field strength). Now, for great values of E, the formula $\rho = \dfrac{0.09}{\sqrt{E}}$ ohm cm may be accepted. On this basis, and taking as an effective value of E as a function of time, $E = E_0 e^{-(R/2L)t}$, the dependence of the column resistance on time may be obtained:

$$R = \frac{0.09l}{\frac{\pi}{4}\sqrt{E_0}}\cdot\frac{exp\left(\frac{Rt}{4L}\right)}{t}\cdot\left(\frac{t}{d^2}\right). \qquad (6)$$

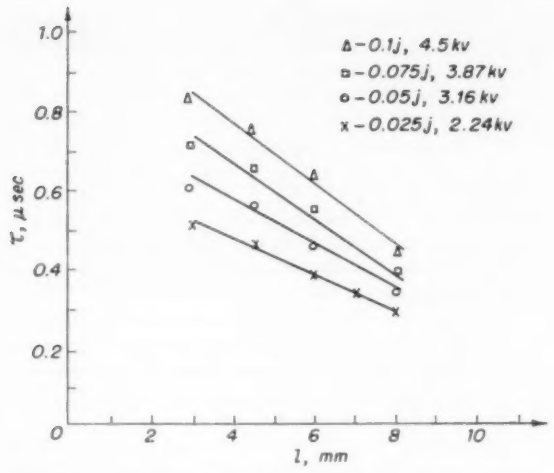

Fig. 17. An example showing the dependence of τ on l (xenon, $p = 3$ atm, $C = 0.01$ μf, $L = 200 \times 10^{-9}$h).

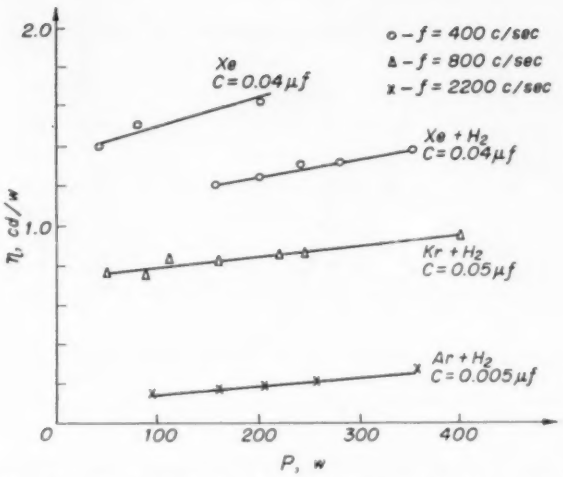

Fig. 18. The dependence of the light output in cd/w on the average wattage P dissipated in the tube at various flash frequencies f ($p = 3$ atm, $l = 6$ mm, $L = 120 \times 10^{-9}$h).

Taking into account that in the range of values of t from $\frac{L}{2R}$ to $\frac{4L}{R}$ (which corresponds to the pulse duration at the level of $\frac{1}{e^2}$) the value $\frac{exp\left(\frac{Rt}{4L}\right)}{t}$ changes insignificantly, the dependence of R_{min} and $(t/d^2)_{min}$ on parameters should be similar. Thus, on the basis of Eq. (3) and (6) we may compute for various discharge parameters the value $\frac{CR^2_{min}}{4L}$, which determines to what extent the discharge is close to the aperiodic condition $\left(\frac{CR^2_{min}}{4L} \geq 1\right)$. Curves are given in Fig. 13. These curves, in agreement with direct experimental observations, show that an unlimited discharge without a ballast resistance may be aperiodic at a flash energy of up to 0.5 j, with an inductance up to 6×10^{-9}h, and a supply voltage up to 2.5 kv. The value of $\frac{CR^2_{min}}{4L}$ decreases most rapidly with increase in voltage. For example, at $U = 5$ kv, the aperiodic condition obtains only if L is lower than 1×10^{-9}h. (For $CR^2_{min}/4L = 0.4$ the discharge is not aperiodic, but is heavily damped, the power dissipating by a factor of 10 in a half period.) The value $CR^2_{min}/4L$ exceeds 0.4 at 2.5 kv and 20×10^{-9}h, or 5 kv and 3×10^{-9}h.

The aperiodic discharge may be obtained using a low-inductance ballast resistance R in series with a tube provided that $\sqrt{\frac{L}{C}} < R < 1.4\sqrt{\frac{L}{C}}$ (for 0.01- to 5-j flash energies).

Electric pulses and light pulses with respective durations 0.05 μsec and 0.1 μsec (on a 35% level) may be obtained *without* any special ballast in $A + 20\%$ H_2 at $p \cong 3$ atm, $l \cong 5$ mm, $L \cong 10 \times 10^{-9}$h, $U \cong 3$ kv and $C \cong 3000$ μμf. Similar pulses may be obtained *with* a ballast at $C \cong 0.01$ μf, $U \cong 8$ kv, $R \cong 1.2$ ohm, and the other parameters as before. In the second case the peak luminous intensity is approximately 40% more than in the first instance. The flash duration, measured by the *brightness* curve, at a 35% level, in the parameter range studied, is about half of the flash duration, measured by the *candle power* curve.

The duration of the light pulse τ from a discharge in a lamp with a spherical bulb *without* any ballast, increases linearly with the square of the voltage on the condenser, with the square root of its capacity, and with the sixth root of the inductance of the discharge circuit (Figs. 14–16). τ decreases with the lengthening of the spark gap (Fig. 17). τ also decreases with the increase of the gas pressure, and the diminution of its atomic number.

With a ballast the influence on τ of all the factors mentioned, with the exception of the nature of the gas, is weaker. The nature of the gas shows its influence just the same as without any ballast.

The light output η (in cd sec/j or in cd/w) of a discharge

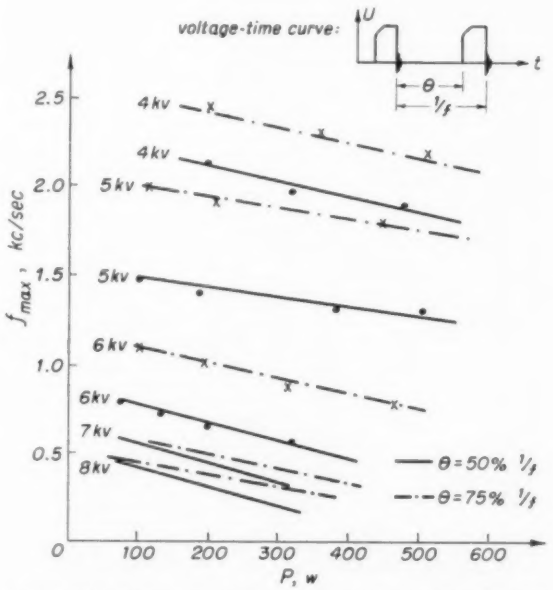

Fig. 19. The dependence of f_{max} on P at different charging current pauses θ (expressed as a fraction of the flashing period $T = 1/f$ in a circuit controlled by a thyratron (Xe + 20% H_2).

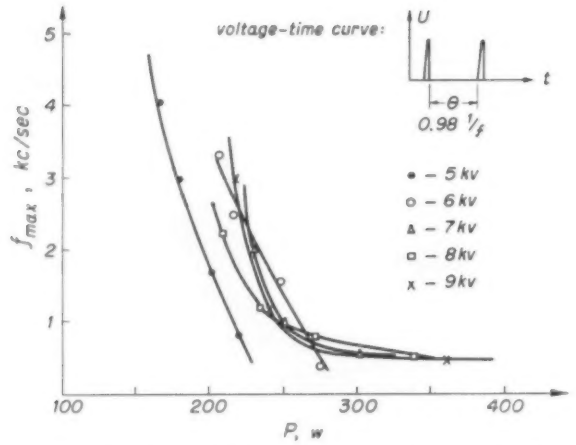

Fig. 20. Dependence of f_{max} on P in a circuit with a "tilting arm."[12]

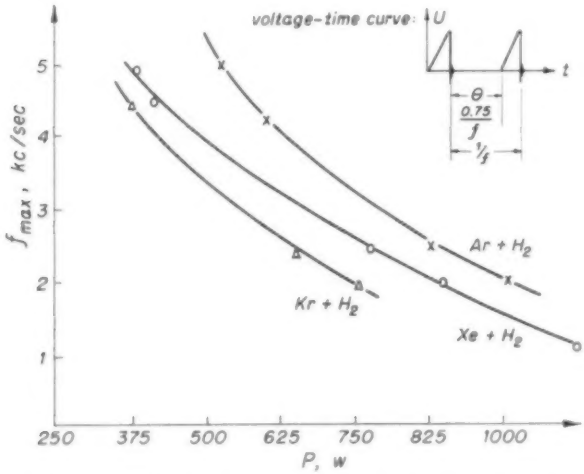

Fig. 21. Dependence of f_{max} on P in a circuit controlled by a vacuum triode (U = 6.5 kv).

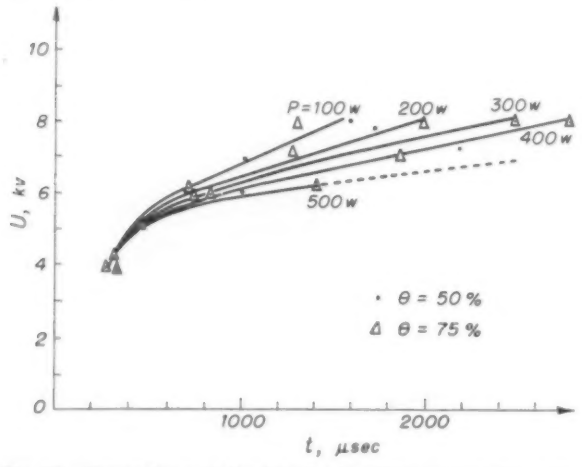

Fig. 22. Dependence of the deionization time on operation voltage at different wattages.

in such lamps changes only slightly with a change in the voltage and capacity of the supply condenser (Fig. 18). The peak candle power per energy unit, with an increase of $CU^2/2$ from 0.05 to 0.8 j decreases from 2.5 × 10^6 to 0.8 × 10^6 cd/j for xenon, and from 1.2 × 10^6 to 0.6 × 10^6 cd/j for argon + 20% hydrogen (p = 3 atm, l = 6 mm, L = 120 × 10^{-9}h, C = 0.005 to 0.04 μf). The decrease of L from 100 × 10^{-9}h to 10 × 10^{-9} h leads to an increase in the peak candle power of 20%. The diminution of the inert gas atomic number or an addition of 20% hydrogen leads to a decrease in the peak candle power by 10 to 20%.

The maximum frequency f_{max} of the flash repetition is connected with the nature of the supply circuit, with the supply voltage, with the power dissipation P, and with the construction data of the tube in respect of the gas filling, the electrode design, etc.

Examples of the dependence of f_{max} on P for three circuits which were used for lamps with a 65-mm bulb diameter, a gas pressure of 3.2 atm, and a 5.5 mm gap between the electrodes, are shown in Figs. 19–21. In Fig. 22 are shown the deionization time curves which were deduced from data on maximum flash frequency.

The data obtained show that there is a possibility of getting 0.3 μsec flashes at a frequency of 5 kc with an average power of 1 kw, without any commutating device in the discharge circuit.

Acknowledgments

In conclusion the authors extend their thanks to V. I. Vassilyev, V. P. Jiltzov, B. V. Skvortzov, R. G. Vdovtshenko, V. F. Razumtzev, A. I. Mironova, M. S. Levtshook, M. I. Epstein and S. A. Yacubovitsh, who took part in the collection of the extensive experimental data presented.

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Submicrosecond Flash Sources

By HAROLD E. EDGERTON, JOHN TREDWELL and KENNETH W. COOPER, JR.

Design details are given for two submicrosecond flash sources for photography by reflected light, silhouette and schlieren techniques. The source for reflected-light photography uses a "guided" air spark operated at 18 kv with 0.05 μf to produce a 0.4-μsec flash with a peak light of 5 million candlepower. The flashtube, a special design, is described, together with its power supply and trigger circuit. The trigger circuit can be operated by a microphone, phototube, contactor or other electrical signal, and incorporates an adjustable time delay. A photograph taken with the unit is shown.

A small spark source capable of producing flashes of about 10 mμsec duration for silhouette and schlieren photography is described. Relative peak light output and flash duration are given as a function of pressure for air, nitrogen, oxygen, carbon dioxide, hydrogen and argon. Gap resistance is given as a function of gap length, for air.

THERE IS an ever-growing requirement for short-time-duration flash sources of light to meet modern demands for experimental information on the high-speed subjects that are being developed. Also, there is now, and will be later at an increased tempo, a real need for such light sources in basic physical and chemical research so that an insight into nuclear and chemical free radical phenomena can be gained.

Returning to photography, there are several clear-cut light source requirements that must be met for present-day demands.

(1) A light source with a flash duration of 1 μsec or less for reflected-light photography.

(2) A light source of *small dimensions* for *shadow* (silhouette) photography. The duration should be in the 0.1–1-μsec range. Film should be exposed to the source at a distance of about 4 ft.

(3) A small light source of very short duration, 0.01–0.1 μsec, for photographing small high-speed subjects using an efficient backlighted optical system.

This paper shows experimental results to assist in the design and use of light sources in categories (1) and (3). Sources in category (2), utilizing restricted end-on gaps, are in use.[1,2,3,10]

Reflected-Light Source

After considerable experimentation, a "guided" air spark[1,4,5,6,11] was selected as a practical source for reflected-light photography. Xenon and argon were rejected since, at the time duration desired, the afterglow of light lasted too long.

Details of the "guided" air-arc source are shown in Fig. 1. The gap is about an inch long on the outside of a 7-mm-OD Pyrex glass tube. Starting is facilitated if the electrodes are adjacent to and in contact with the tube walls since starting is definitely a surface phenomenon. The 18 kv applied to the electrodes is insufficient to cause an arc to start; however, if a high voltage is suddenly impressed on the *inside* of the tube, conduction starts very quickly. The inside diameter is about 2 mm in the tube illustrated. Air at atmospheric pressure is used as a gas since the afterglow of light following the flash is of short time duration and of a red color. Figure 2 shows an oscillogram of the light output of the bare lamp, whose one-third-peak duration is about 0.4 μsec and whose peak light is about 5 million horizontal candle-power.

The lamp is excited by two series capacitors totaling 0.05 μf charged to 18 kv, which store about 8 watt-sec of electrical energy. The efficiency is about 0.25 horizontal candlepower per watt. Every effort must be made to keep the inductive wire loops in the discharge circuit to a minimum if the flash is to be of short duration.

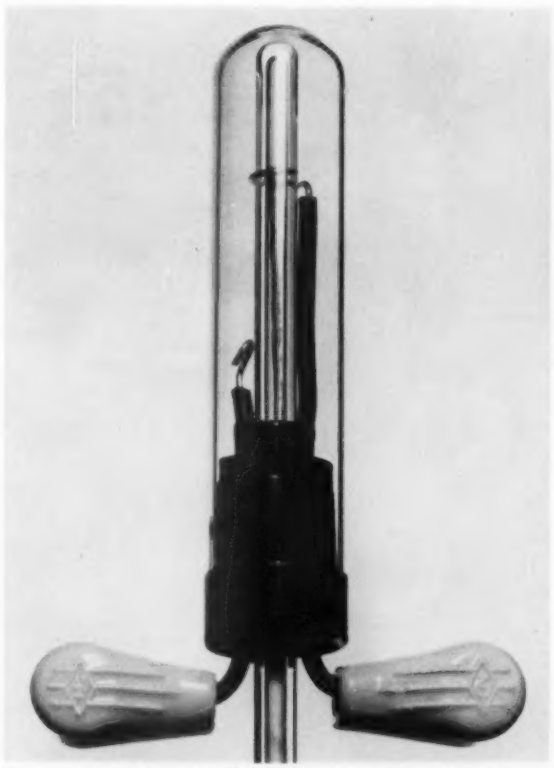

Fig. 1. A "guided spark" flashlamp using a Pyrex tube (7-mm OD, 2-mm ID) with an internal trip wire and a 1-in. gap on the outside of the tube.

Presented on October 17, 1960, at the Fifth International Congress on High-Speed Photography, Washington, D. C., by Harold E. Edgerton, John Tredwell (who read the paper) and Kenneth W. Cooper, Jr., Dept. of Electrical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.

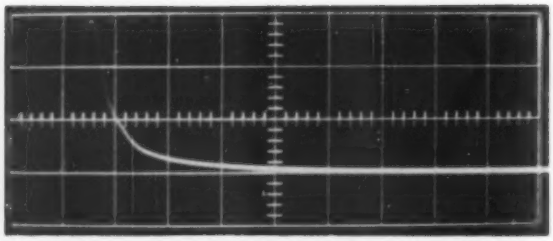

Fig. 2. Light output from the lamp of Fig. 1 as a function of time when flashed from 0.05 μf charged to 18 kv.; (Horizontal scale — 0.5 μsec/sq).

Table I. Experimentally Measured Duration and Output Information of Four Capacitors of the Type Shown in Fig. 5 with a 3-mm Rounded-Point Air Gap.

Capacitance, $\mu\mu$f	d, in.	D, in.	E, in.	Peak-light candlepower*	Duration, mμsec*	Output, cps†
70	0.007	0.625	1.00	2,600	10	30×10^{-6}
167	0.007	0.625	1.25	11,500	15	200×10^{-6}
340	0.007	0.625	1.75	72,500	25	2000×10^{-6}
580	0.007	0.500	2.325	82,500	45	4000×10^{-6}

* Measured on an EG&G Traveling-Wave Oscillograph, Type 2236.
† Candlepower-seconds.

A $\frac{7}{8}$-in.-OD glass tube is used to insulate the high voltage from the reflector and also to reduce the noise from the spark. Also, rubber is used at the open end of the outside tube to reduce the noise of the spark.

For bullet photography, the light output should be concentrated into a narrow beam so that an intense spot can be aimed at the event. The assembly can be mounted into a box for practical use, as in Fig. 3. Here a specular reflector produces a spot of about 10-in. diameter at a distance of 3 ft from the lamp. An aperture of $f/8$ is suitable with Panatomic X film, especially if a light background can be used to outline the dark portions of the bullet, and if prolonged development is employed.

Triggering of the light at the desired instant to catch the action is often the most difficult task in high-speed photography. Various methods involving electrical contacts, microphones or phototubes are employed, depending upon the problem at hand. Figure 3 shows a trigger unit employing all the above methods. An adjustable time-delay circuit is also incorporated in the circuit so that different phases of an action that can be repeated can be studied as desired.

Figure 4 shows a .22 caliber long rifle bullet photographed with reflected light from the air-flash guided spark unit which has just been described, at $f/8$ on Royal Pan Film.

Ultra-Short-Duration Light Sources

Some of the factors that influence the flash duration are (1) the resonant frequency of the energy storage capacitor and the entire discharge circuit including the inductance in the capacitor; (2) the effective resistance of the entire discharge circuit including the lamp; and (3) the afterglow in the gas after the current has ceased to exist.

Fig. 3. Equipment for producing short flashes of light for photographing fast subjects by reflected light. Either sound, light or voltage signals can be used to synchronize the flashes with the subject.

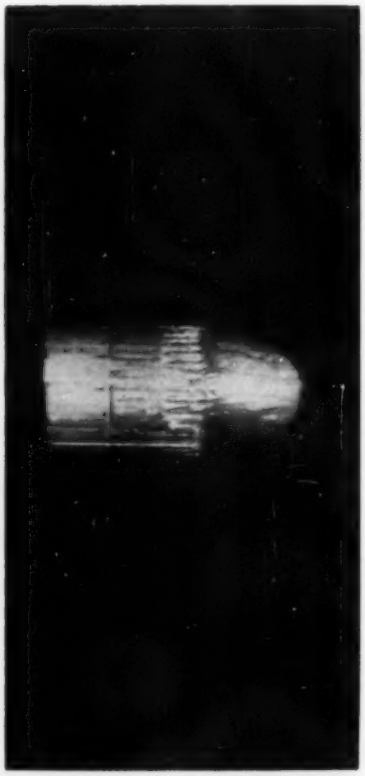

Fig. 4. Photograph of a .22 long rifle bullet taken with the electronic flash equipment shown in Fig. 3.

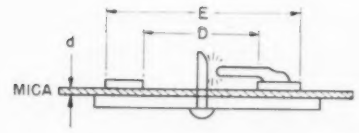

Fig. 5. Drawing of a doughnut-shaped low-inductance capacitor, the output of which is described in Table I.

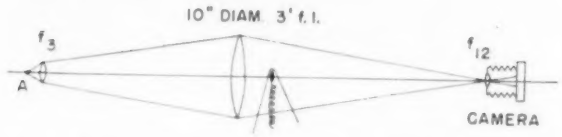

Fig. 6. Optical arrangement for obtaining backlighted photographs with minimum light at source A, using fast film in the camera.

One of the present authors[7] has measured the light output and duration from self-triggered sparks from doughnut-shaped mica capacitors. The measured values and the dimensions of the capacitors are given in Table I (refer also to Fig. 5). From the information in Table I, one sees that the flash duration and output are related. So if one desires a 10-mμsec exposure, the optical system must be capable of making a photograph with a light output of 30×10^{-6} cps. The only way to get a photograph with such a small quantity of light is to use an efficient backlighting system. For example, Fig. 6 shows a typical system used with 10- and 15-mμsec flashes of light from a source of the type illustrated in Fig. 5.

Effects of Air-Gap Length

Low-energy sparks are influenced by the nonlinear effects of the spark gap. A series of experiments was made[8] to find the effective resistance as a function of air-gap length and frequency for a capacitor of about 100 $\mu\mu$f. An EG&G Traveling-Wave Oscillograph, Type 2236, was used to record the frequency and attenuation of the flux coupled into a small search coil near the discharge circuit. "Resistance," as plotted in Fig. 7, was obtained by measuring the magnitude ratio of intensity per half-cycle. The "effective resistance" is the theoretical value of resistance to give the same transient.

The *critical* damping resistances R_c for the three curves shown in Fig. 7, as calculated from the equation $R_c = 1/Cf$, are indicated below the appropriate curves.

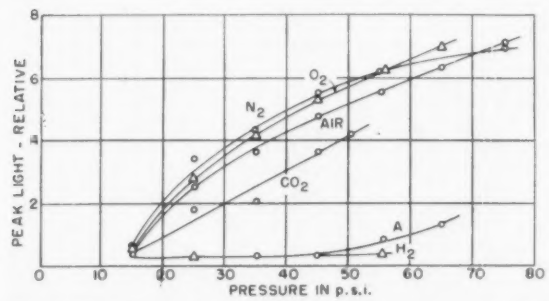

Fig. 8. Relative peak light output from a 130-$\mu\mu$f capacitor in several gases as a function of pressure.

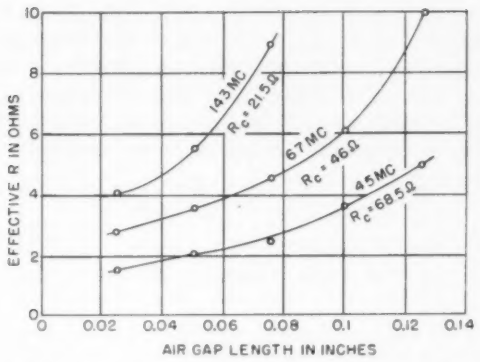

Fig. 7. Effective resistance as a function of gap length for a capacitance of 130 $\mu\mu$f for three discharge frequencies: 143, 67, and 45 Mc/sec.

Here C is the capacitance in farads and f is the frequency of the discharge circuit. None of the points shows a critically damped condition. Often a circuit can be made to have a shorter flash if a noninductive resistor is put in the discharge circuit, but a loss of efficiency in producing light will result.

Pressure and Gas

A mica-insulated doughnut capacitor of 130 $\mu\mu$f of the type shown in Fig. 5 was mounted in a pressure cylinder so that the effects of different gases and pressures could be studied. The light was observed through a Plexiglas window by a 929 phototube (S-4 surface) with 2500 v on the plate. The signal current was connected to an RG-8U coaxial cable and a delay line before being connected to the plates of an EG&G Traveling-Wave Oscillograph.

Figure 8 shows the peak light output on a relative scale as a function of pressure in pounds per square inch. Helium, as well as nitrogen, oxygen, air, carbon dioxide, argon and hydrogen, was tried. The helium output was too small to be entered on the chart.

The flash duration (one-third peak) is shown in Fig. 9 for the same experimental arrangement and gases as were used in preparing the data of Fig. 8.

Further experiments were made in air with a 12-$\mu\mu$f low-inductance capacitor having a gap of 0.05 in., at the several pressures listed below, with measured flash durations T.

p = 45 psi, T = 7.4 mμsec
p = 35 psi, T = 4 mμsec
p = 25 psi, T = 2–3 mμsec

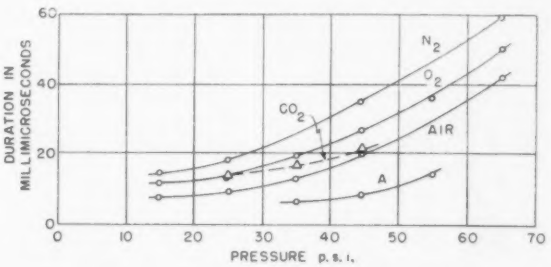

Fig. 9. Flash duration (one-third peak) as a function of pressure and gas content for a mica doughnut capacitor of 130 $\mu\mu$f.

The light from the weakest spark, which had a flash duration of 2–3 mμsec, was enough to obtain a silhouette photograph with an efficient optical system. A study of the influence of capacity and pressure suggests that a smaller capacitance at a higher pressure might produce a shorter flash with sufficient light for very-short-time photography.

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The Improved f/10 Sweeping-Image Camera: A Versatile Model for Explosive Research

By BERLYN BRIXNER

The previously described f/10 sweepimg-image camera has been equipped with a series of refined accessories to adapt it for a wide variety of explosive research problems. In order that the camera may be used with an assortment of objective lenses, it has been equipped with the following adjustable accessories: camera and lens mounts, demountable lenses, remote-control focusing, slit holder mount, field lens mount and viewfinder. Attachments which help in obtaining the correct relative adjustment between the object and the final image are an illuminated-slit projector, a precision mount for the astigmatism correcting lens, and a sweeping-image viewer. To safeguard personnel in the event of a mirror explosion during camera operation, an armor plating has been installed. This work was done under the auspices of the U.S. Atomic Energy Commission.

For routine explosive testing, the earlier $f/10$ high-speed rotating-mirror sweeping-image camera[1] with its correcting lens for mirror distortion proved so successful that a demand grew for a versatile model which could be used for a large variety of explosive research problems. The camera which is to be described was developed to meet this demand. It resulted from suggestions made by the author and his associates, by the users of the earlier camera and by the prospective users of the proposed camera. This paper will concentrate on the improved designs specifically developed for this research camera but will also include detailed discussions of certain basic features only partially covered in the previous paper.[1] The principal refinement is the ability of the improved camera to use objective lenses of a variety of focal lengths.

Features which this camera shares with the earlier model and which will not be discussed are: the apochromatic imagery of a 3-in.-long slit at $f/10$, a 20-in. writing arm to sweep the image at 13 mm/μsec when the rotating mirror revolves at 2000 rps and an adjustable cylinder lens to correct the astigmatism produced by mirror distortion at all but the highest speeds of rotation.

The new design features to be described are: the camera and lens mounts, the slit holder, the field lens, the corrector-lens focusing mount, the capping shutter, the synchronizer, the viewfinder microscope, the sweeping-image viewer, the slit projector and the armor-plate shield.

Figure 1 shows the optical diagram for this camera, which has a different viewfinder from the earlier model. The objective lens L_1 images the object O on the slit S. The part of the image that is to be photographed passes through the slit and is re-imaged by lens L_4 at the film F, after reflection from the rotating mirror RM, which sweeps this second (line) image across the film. The film record thus has space and time dimensions for its two coordinates. Lenses L_2 and L_3 are used to improve the operation of the basic optical system. The use, near the slit, of field lens L_2, which is of appropriate focal length to produce an image of L_1 at L_4, corrects the illumination defect which occurs at the slit ends when long slit images are used. The introduction of an appropriate negative cylinder lens L_3 largely compensates for the distortion of the rotating mirror RM, whose sur-

Presented on October 20, 1960, at the Fifth International Congress on High-Speed Photography, Washington, D. C., by Berlyn Brixner, Los Alamos Scientific Laboratory, University of California, Los Alamos, N.M.

face at high speeds is changed to a circular cylinder, thus introducing astigmatism into the image at the film *F*. The low-power compound microscope *MS* is used for observing the static image *I* at the film surface *F*.

Figure 2 shows the camera assembly installed in an ordinary laboratory room. The camera here is to be used for the study of sparks, exploding wires and miniature explosive charges which on detonation can be contained in the box, shown at the center, which is of a welded-steel construction with Lucite-window viewing ports on two sides to permit the use of backlighting when desired. A stand at the extreme left positions the condensing lens when backlighting is used. Between the box and the camera are seen, first, the ring of miniature lights used to illuminate the object for focusing and for static photography and, then, an enlarging objective lens. The camera box is shown in readiness for photography with the armor hood closed. The relay rack at the right contains, from top to bottom: a LASL GMX-7 Model 908 oscilloscope, a Hewlett Packard variable audio-oscillator used to check the rotating-mirror speed, the synchronizer power supply, an 800-cycle tuning-fork oscillator standard and a 10-kv power supply for a triggered spark gap.

Camera and Lens Mounts

In adapting the camera for use with lenses of a variety of focal lengths, the requirements were to provide more working distance, to make the size of the mount and the spacing between the objective lens and the camera readily adjustable for specific research problems and to provide remote-control focusing. These needs were met by increasing the bed length to 12 ft and providing the lens and camera slides with quick-action setscrew locks. To accommodate larger lenses and an adjustable object stage, the height of the optical axis of the system was raised. To make shuttering independent of the objective lens used, the capping shutter, previously part of the

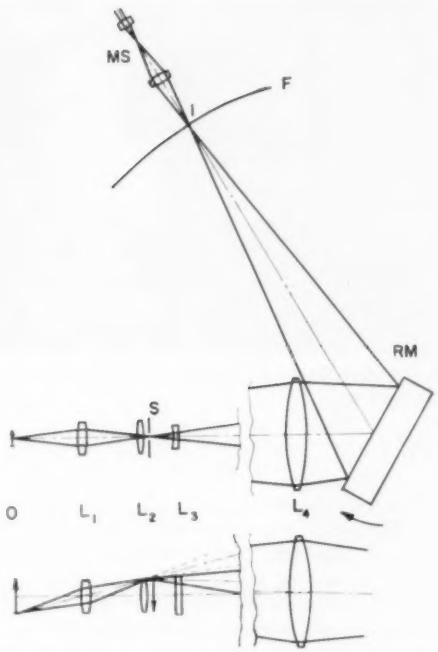

Fig. 1. Optical diagram of sweeping-image research camera.

objective lens, was moved to the camera interior. Finally, the objective-lens focusing mount was increased in size and was adapted for interchangeable lenses, and an electric motor was substituted for the manual drive.

The new mount with its remote-control switch is shown in Fig. 3. It has a lens board which will accommodate lenses with barrels up to 5 in. in diameter. Much larger lens mounts can also be installed. The lenses are mounted

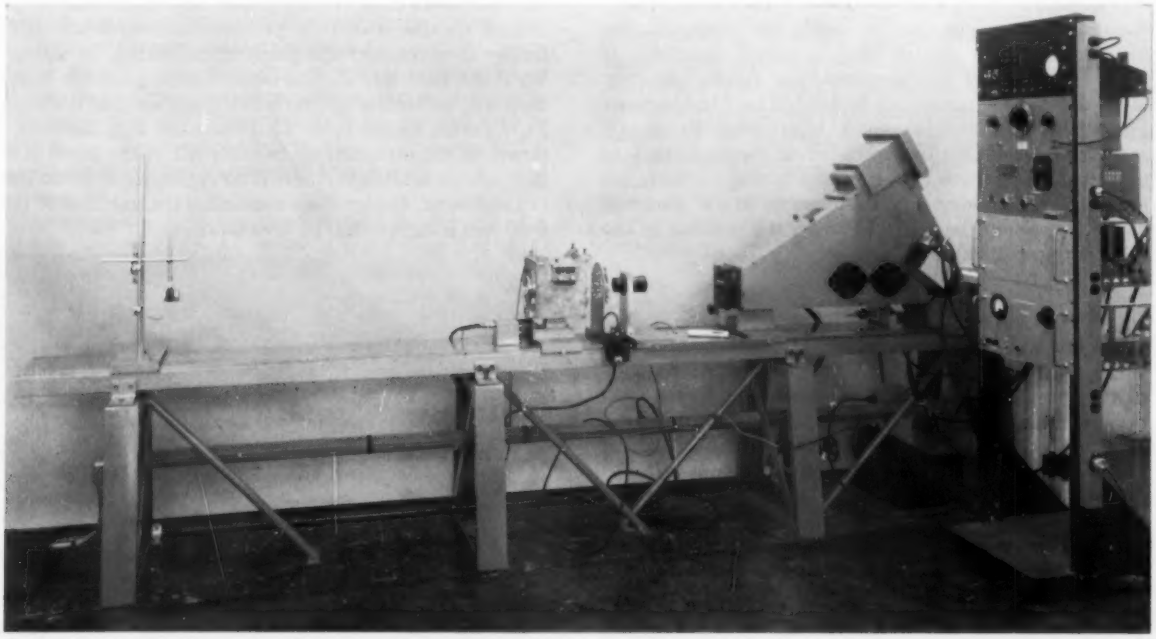

Fig. 2. General view of sweeping-image research camera.

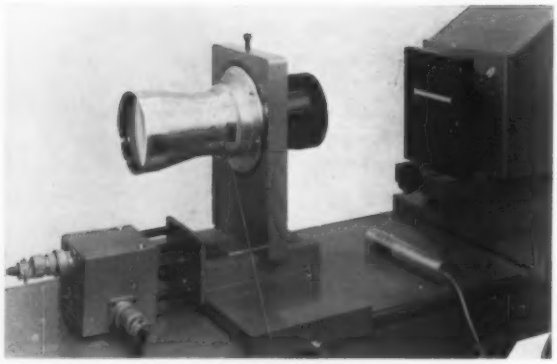

Fig. 3. Electrically driven lens-focusing mount and adjustable slit holder.

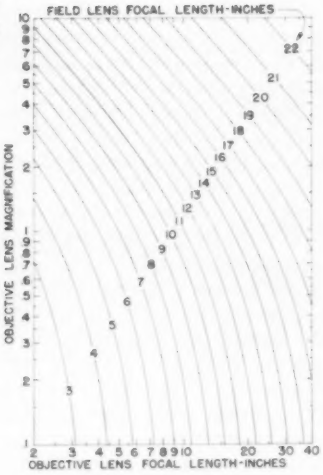

Fig. 4. Nomograph of objective-lens focal length and magnification vs. field-lens focal length.

on interchangeable metal plates. The lens shown is the Kodak Z-81 apochromat, 15-in., $f/4.5$, for operation at 1 : 1. The lens and its circular mounting board are quickly removed by loosening the setscrew at the top. And a reversible electric motor makes possible the remote-control focusing now necessary because the objective lens is out of reach of the operator who is determining the focus at the film plane.

The motor has a long extension cable and a handle with two pushbutton switches to control the direction of motion of the lens. The 115-v a-c motor runs at 12 rps to give a slide motion of 0.0125 in./sec, a speed quite satisfactory for lenses operating at $f/10$ aperture or smaller. No change was made in the threaded rod which moves the dovetail slide. Interlocked limit switches control the maximum motion of the slide and stop the motion before the slide is jammed against either end. When the limit switch has been tripped by too much motion in one direction, the slide can be reversed by depressing the other remote-control pushbutton switch. Required clearances can be made by mounting the fo using assembly on the bed in either direction; if necessary, in tight arrangements, the shorter old-style manual focusing mount can be used. The Merkle-Karff Flexo-Action reversible motor with 10-in.-lb torque at 12 rpm, available in a number of speeds from 1 to 60 rpm for operation on 115-v alternating current, has been very satisfactory. The thumbscrew at the near side of the lens-mount base is used to fix the position of the assembly on the bed.

Slit Holder

On the end of the camera box at the right of Fig. 3 is the slit holder. The slit, which is on a 0.040 by $\frac{1}{2}$ by $3\frac{1}{4}$-in. glass plate, is made by the shadowgraph evaporation technique described elsewhere.[2] The plate is mounted on a readily removable slide so that it can be quickly exchanged either for slits of other sizes or styles* or for a clear aperture with a fiducial line for focusing and viewfinding. The central positions of the various slits and of the fiducial line coincide within ±0.0002 in. The slide with its mounted slit is seated in the vertical upright on the manually operated dovetail slide. This arrangement permits adjustment along the optical axis so that any type of slit which would fit into the holder could be brought into critical focus at the film surface. The field-lens holder to be described in the next section is bolted onto the upright.

Field Lens

In addition to the variety of objective lenses needed to give this camera the required versatility, a similar range of field lenses makes it possible to choose for each setup a field lens which assures even illumination across a large film image by preventing a reduction of image brightness at the slit ends. The problem is illustrated in the lower part of Fig. 1, which shows a plan view of the path of an image-forming bundle from the end of the object O. L_1 images the object point on the slit S. In the absence of the field lens the image-forming bundle would proceed as shown by the dashed lines and would fail to enter L_4 at all. Image points from the center to the end of the slit would be progressively vignetted until finally they reached the point of extinction, as shown. With the field lens L_2 the image-forming bundle is redirected, as shown by the solid lines, so that it enters L_4. L_2 must image L_1 at L_4. (Corrector lens L_3 has no power in the direction of the slit.) All image cones pass through the relay lens; there is no vignetting to cause loss of brightness. Under these conditions the selection of the field lens is determined by the equation

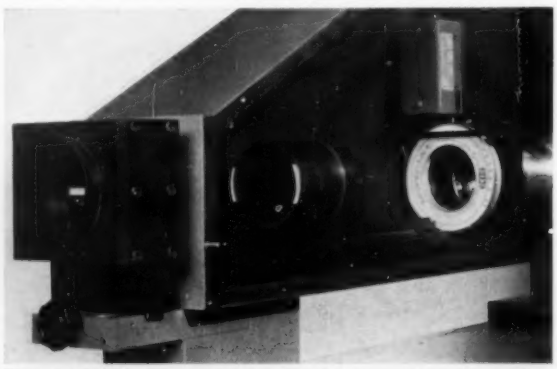

Fig. 5. Field-lens mount, corrector-lens mount and capping shutter.

* One very useful style is our adjustable bilateral slit with 2½-in.-long jaws. These jaws are on a parallelogram frame and can be opened to a maximum of 0.1 in.

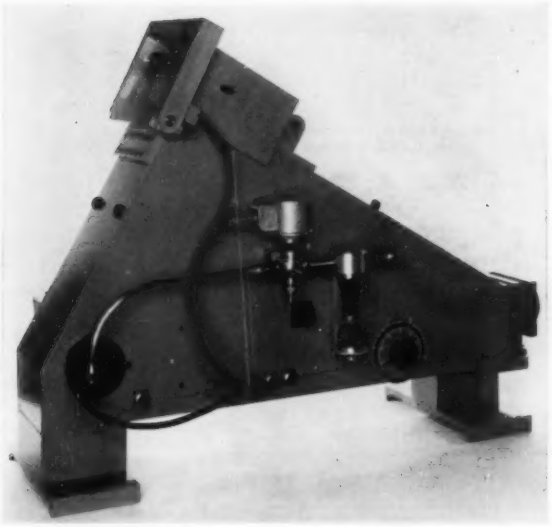

Fig. 6. Back side of sweeping-image research camera.

$$f_F = \frac{f(M+1)v}{f(M+1)+v}$$

where f_F is the focal length of the field lens, f is the focal length of the objective lens, M is the magnification of the image produced by the objective lens, and v is the rear conjugate of the field lens, which for this camera is 24 in.

The relationship of the three variables is shown in the nomograph of Fig. 4, which includes most of the useful possibilities. The region at the lower left is not useful on long slit images because of the excessive curvature of field caused by the field lenses of short focal length. It is obvious that uniform image sharpness on a straight slit cannot be obtained if the image is spherically curved. The extent to which the field curvature may be increased without excessive loss of resolution must be determined for each set of experimental conditions.

To permit rapid changing of lenses, a large set of simple field lenses, together with a simple adjustable mount, is provided. The circular field-lens cell and its mount are shown at the left in Fig. 5. The lens cell is easily removed and the simple lens quickly exchanged when desired.

Although the field curvature caused by the use of a simple field lens may be removed if the field lens is incorporated into the initial design of the objective lens, this obvious solution is not satisfactory here because it would limit the range of conjugates with which the lens could operate satisfactorily. The next best solution is the one which makes it possible to use commercially available lenses in combination with a simple crown-glass field lens adjacent to the slit, as described above. Less favorable, because of the greater image curvature introduced, is the cemented or air-spaced achromat which must be used if there is appreciable space between field lens and image. The large chromatic aberration of the simple lens makes this choice of field lens necessary. The more complex anastigmats do not appear to be useful as field lenses because they are cumbersome, and other aberrations usually cause an even greater loss of resolution than results from use of the simpler lens forms.

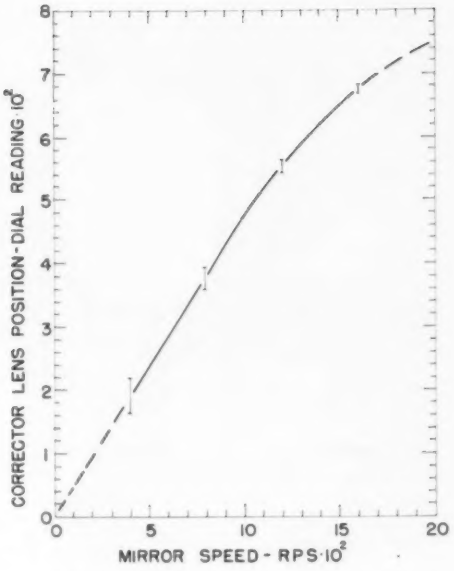

Fig. 7. Corrector-lens position vs. rotating-mirror speed.

Often field lenses, with their associated aberrations, may be dispensed with, since vignetting of up to 50% of the light is frequently tolerable.

Corrector Lens and Capping Shutter

Replacing the simple corrector-lens slide used in the earlier camera is a dovetail slide with a rack and pinion drive, as shown in the interior of the camera at the center of Fig. 5. The rectangular plano-concave cylinder corrector lens (−100-in. focal length) may be seen at the near end of its circular mount. The slide has a range of more than 9 in. so that the lens may be positioned adjacent to the slit for static setup pictures and spaced far enough away to correct mirror distortion up to the maximum speed of 2000 rps. The apparatus used to determine the best corrector-lens position for cancelling the aberration produced by the distortion of the rotating-mirror surface in the high centrifugal field will be described in the section, "Sweeping-Image Viewer." The lens slide is actuated by a pinion gear on the drive shaft

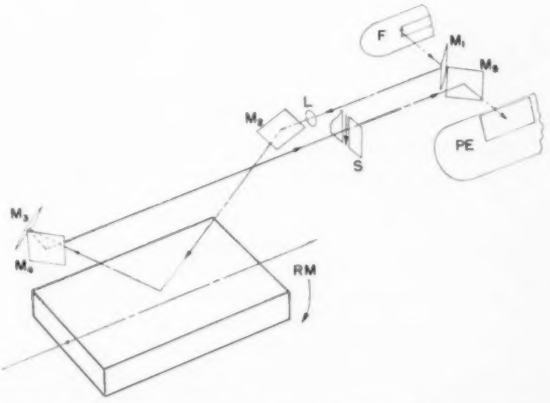

Fig. 8. Perspective optical diagram of photoelectric synchronizer.

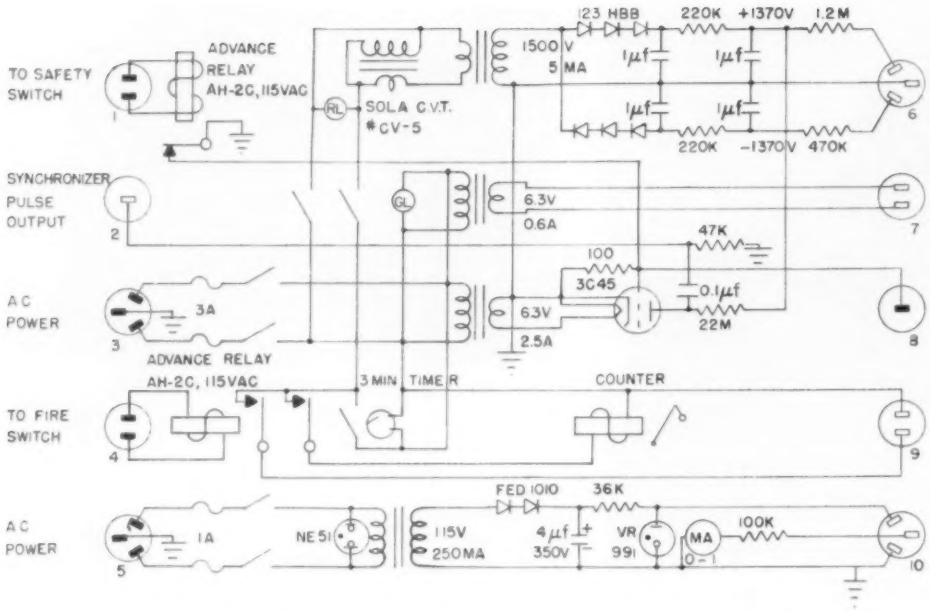

Fig. 9. Wiring diagram of power supply for photoelectric synchronizer.

of a vernier potentiometer dial mounted on the side of the camera opposite to that shown in Fig. 5. This dial, which is shown at the lower right of Fig. 6, has 1000 divisions over its full range of motion.

The results of corrector-lens performance tests with the sweeping-image viewer are shown in Fig. 7, which gives the optimum corrector-lens position vs. the rotating-mirror speed. The lens position, as would be expected, is a linear function of mirror speed. This linear relationship does not mean that the static resolution of 36 lines/mm is maintained at the highest speeds. Visual observation of the resolution suggests that the compensation is adequate to maintain resolution up to about 1500 rps and that the resolution thereafter falls off faster than the writing speed increases, so that there is probably no gain in resolving time at higher speeds.

Somewhere in the camera's optical system a mechanical capping shutter is always required to control exposure of the film to general illumination in the object space. Because of availability and convenience of operation, a between-the-lens type of shutter is generally used. The shutter is located on the camera-case rib in front of the Z-81 relay lens, as shown to the right in Fig. 5. An Ilex #5 synchro shutter was used because of its $2\frac{1}{2}$-in. aperture, self-cocking action and the electrical contacts which close when the shutter blades are fully open. A port in the side cover of the camera gives access to the shutter-speed adjuster. The shutter is opened or closed manually by pulling or pushing a knob attached, on the opposite side of the camera (seen in Fig. 6), to the rod link shown. A Beattie shutter actuator, which is to be seen on the rib just above the

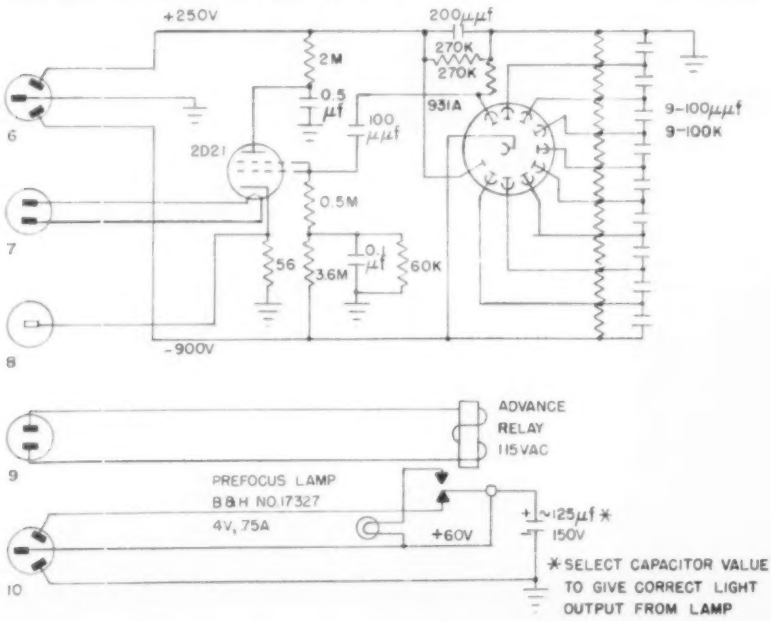

Fig. 10. Wiring diagram of photoelectric synchronizer.

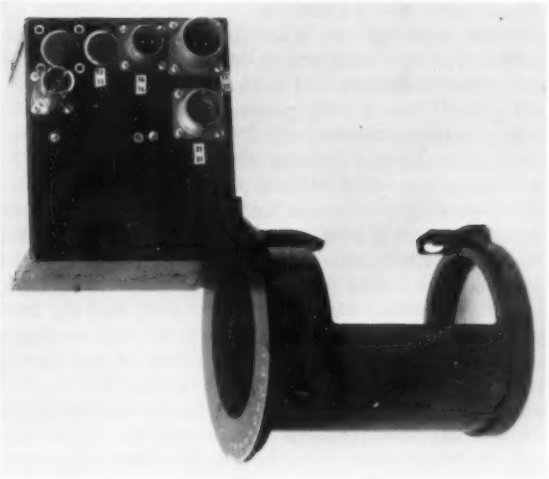

Fig. 11. Photoelectric synchronizer.

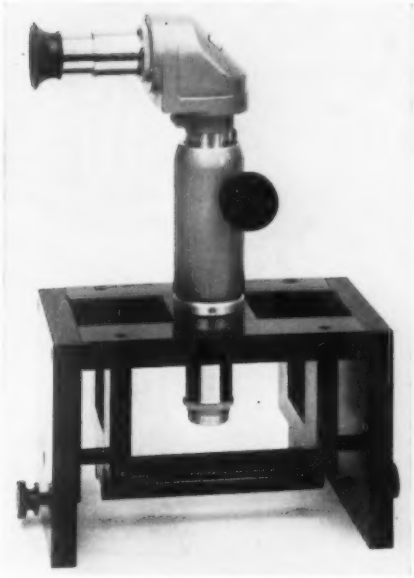

Fig. 12. Viewfinder microscope.

shutter, makes possible automatic remote 110-v a-c electrical operation. A short rod connects the actuator with the shutter. One method by which the shutter contacts may be used as a camera interlock is to place them in series with the firing line. These shutter contacts handle reliably a load of 1 amp at 115-v alternating-current for the normal $\frac{1}{10}$ sec operating time.

Synchronizer

Full details about the optical and electrical characteristics of the photoelectric synchronizer which controls the explosive firing are included here because they were omitted from the earlier paper.[1] The synchronizer is a table assembly surrounding the turbine-driven rotating mirror in such a way that, at the highest writing speed, it can be phased as needed to give up to 100 μsec between the triggering pulse and the initial photography of explosive phenomena.

Figure 8 illustrates in perspective the optics of the photoelectric synchronizer. Mirror M_1 reflects light from the incandescent-lamp line filament F to the enlarging lens L and to mirror M_2, whence it is directed to the surface of the rotating mirror RM, to the folding mirrors M_3 and M_4 and finally back across the system to slit S, where an enlarged image of the filament is formed. Light going through the slit aperture passes on to mirror M_5, where it is reflected to the photocathode of the 931A photomultiplier tube PE. Motion of the rotating mirror causes the filament image to sweep across the slit aperture and pulse the phototube. Each light pulse gives a corresponding electrical pulse at the tube output. This electrical pulse is used to trigger a 2D21 thyratron, which in turn triggers a 3C45 thyratron to give pulses of higher voltage and power than those coming from the photomultiplier. The output pulse may be used to trigger an electric-detonator firing device.

The electrical circuits used with the synchronizer are shown in Figs. 9 and 10. Figure 10 shows the part of the circuit constructed in a box attached to the metal parts of the synchronizer assembly. The relay in the firing line discharges the condenser through the incandescent lamp to give a light source for the phototube. To provide this light pulse, the light need be at high intensity for only one revolution of the rotating mirror. The electrical pulse from the phototube trips the 2D21 thyratron to give a larger pulse, which a coaxial cable transmits to the 3C45 thyratron.

Figure 9 shows the circuit of the power-supply chassis, which also contains the 3C45 thyratron, a counter, a delay timer and control relays. Any of the several types of electric-detonator firing schemes may be triggered by the output pulse from this circuit.

Figure 11 shows the photoelectric synchronizer assembly removed from the camera. The box at the upper left contains the incandescent lamp, the photoelectric tube and the 2D21 thyratron. This box is fastened to the housing which surrounds the rotating mirror, as shown at the lower right. The view is opposite to that shown in the optical diagram.

Viewfinder Microscope

The viewfinder microscope assembly, shown in Fig. 12, consists of a low-power compound microscope mounted on a frame which may be clamped onto the circular track of the film holder. A 90° prism facilitates viewing by the operator. Since the microscope is fitted into a slide, the entire length of the slit image may be scanned. By clamping the assembly along the length of the film holder, one may observe images over the entire usable film area. Because the ends of the central double-bar positioning guide rest on the lateral film guides, they point the microscope toward the rotating mirror so that it receives the beams unvignetted from the image at the film surface. Since the image is normally viewed with the fiducial line in place, an extended area of the object can be observed, while at the same time the fiducial makes it easy to identify the part which will be photographed. Observation of the parallax between the images of the object and the fiducial determines the

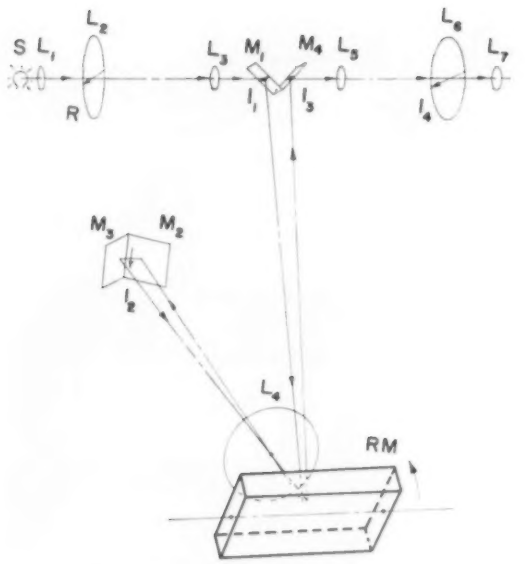

Fig. 13. Optical diagram of sweeping-image viewer.

focus. Changing the focus, while observing the image, is accomplished by means of the remote-control switches of the electric-driven objective-lens focusing mount.

Sweeping-Image Viewer

Centrifugal forces acting on the rotating mirror distort its surface and produce astigmatism at the film image. To measure this astigmatism, an optical device called the sweeping-image viewer was developed. This device makes it possible to see the sweeping image of a rotating-mirror camera as though it were the normal static image. The cancellation of the image sweep for a very short section of its arc accomplishes this trick.[3] The length of arc used is about $\frac{1}{16}$ in. because longer arcs do not entirely cancel image motion, and the resolution suffers. Since the image motion normal to the direction of sweep is not cancelled, it is easy to notice the lateral shift of the image due to random or vibrating motion of the mirror. Likewise, one may observe the astigmatism introduced by cylinder distortion of the rotating-mirror surface and thus measure the shift in focus. After the astigmatism has been measured, a cylinder corrector lens is introduced to neutralize this defect. The optimum setting of the cylinder corrector lens is determined by this same sweeping-image viewer.

Figure 13 shows a perspective optical diagram of the sweeping-image viewer, which is designed around the relay lens and the rotating mirror of the camera. At one end of the system there is a reticle projector and an image-viewing microscope assembled as a unit; at the other end there is a roof-mirror reflector. The focal surface of the film contains the axis of the projection and viewing optics. The light source S and the condensing lens L_1 illuminate the reticle R on field lens L_2. Projection lens L_3 makes a reduced image I_1 of the reticle on or near the surface of mirror M_1, which in turn directs the light to the camera's rotating mirror RM and its relay lens L_4 to form an image I_2 in the median plane after it has been reflected from mirror M_2 of the roof mirror, whose apex is at the slit plane. The light is then redirected by mirror M_3 back through the relay lens and the rotating mirror to form an image I_3 at M_4. Because the double reflection at M_2 and M_3 reverses the angular motion of the beams in the sweep direction, the image I_3 is stationary. By means of the low-power compound microscope, consisting of lenses L_5, L_6 and L_7, this image may be observed and, if desired, it may be photographed with an ordinary camera attachment, not shown here.

The sweeping-image viewer attachment shown in Fig. 14 is designed around a laboratory microscope which has a rack-and-pinion drive for axial focusing. Three of these microscopes are mounted on the frame as shown. At the right is a microscope equipped with a lamphouse and reticle to convert it to a projector. At the center is a vertical microscope body which holds at its end a small prism, two faces of which have been aluminized to make a bimirror which, when moved vertically, adjusts the separation of the reticle image from the median plane of the camera. At the left is the microscope for viewing the return image. In the center foreground the roof mirror is shown in its mount.

Slit Projector

The slit projector was designed to facilitate alignment of the object to be photographed. It permits use of the camera as a static projector which can throw into

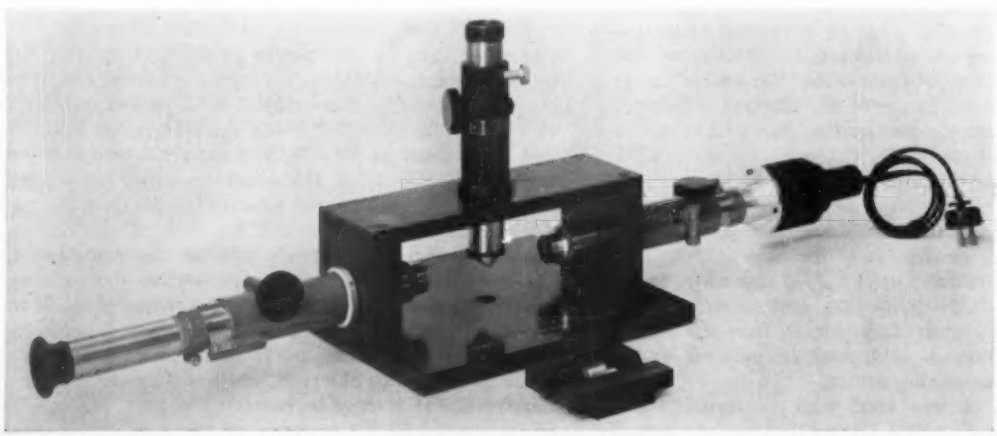

Fig. 14. Sweeping-image viewer.

the object space a bright-line image of the slit. Ease of alignment is especially desirable in explosive research because the camera is usually located in a steel and concrete bunker with only a small bullet-proof glass window giving access directly to the explosive area. If the object is aligned and focused in the usual manner by observation of the image at the camera, a great deal of time is consumed in going to and fro between object and camera to adjust the object so that its image is correctly oriented on the slit. The combination of remote-control focusing and a bright-line slit image projected on the object facilitates adjustment of the object while at the same time one can observe the relative positions of the object and the slit. Although the slit image is not bright enough to be seen when the object is in direct sunlight, it is clearly visible in normal room illumination of 50 candles/sq ft. The projector fits onto the camera in place of the film cassette. The mirror positioner on the turbine automatically aligns the rotating mirror in the correct position for projection. And when an enlarged image of the tungsten-ribbon filament is projected onto the camera side of the slit, the objective lens images at the object the light passing through the slit.

Figure 15 shows the optical diagram of the projector. Light from the ribbon filament *RF* passes through projection lens L_1, is reflected by mirror *M* to form a 3-in.-long image at the film focus *F*. This image is relayed to the slit by the camera relay lens. To give the projected image even illumination throughout its length, field lens L_2 images the pupil (enlarging lens) P_1 at the pupil P_2 of the camera relay lens.

Figure 16 shows the slit projector. The transformer at the right is the power supply for the ribbon–filament microscope-illuminator lamp (type 18A/6V/T10 MED. PF/SR8), shown at the upper left. At the upper center is the housing which contains the projection lens and the mirror. (The projection lens consists of a double-convex simple lens of 41-mm focal length by 33-mm diameter.) At the bottom of the picture is the simple convex field lens, of 182-mm focal length by 76-mm diameter. Through the lens one can see the large filament-image aperture. The whole assembly is mounted on a base plate seated in the same aperture as the cassette holder, and it is locked in place by the same screws used to position the latter.

Fig. 16. Slit projector.

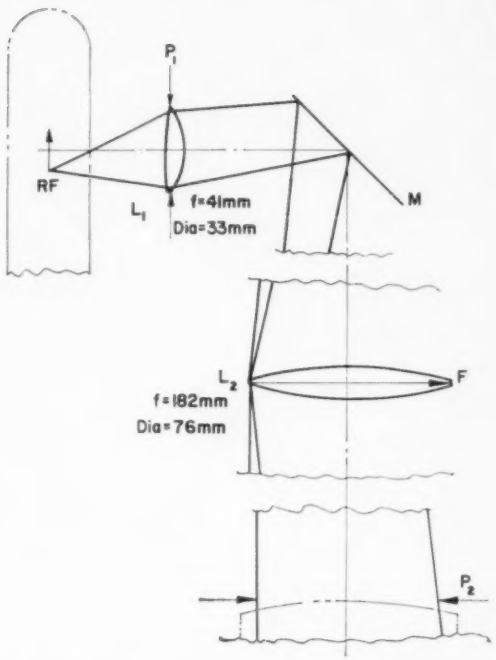

Fig. 15. Optical diagram of slit projector.

Armor Plating

Another innovation introduced with this camera is the armor plating used as a protection in case the steel mirror should explode while rotating at high speed. To protect personnel who must sometimes be in the vicinity when the turbine is running, an armor plate covers the periphery of the rotating mirror so as to contain all the fragments in the event of an explosion. The armor assembly consists, first, of a box surrounding most of the turbine drive and the path between the mirror and the film and, second, of a hinged hood covering the film cassette and overlapping the first box. Both boxes are made from pieces of $\frac{1}{2}$-in. sheet-steel armor plate welded together and heat-treated to maximize their resistance to penetration by high-velocity fragments.

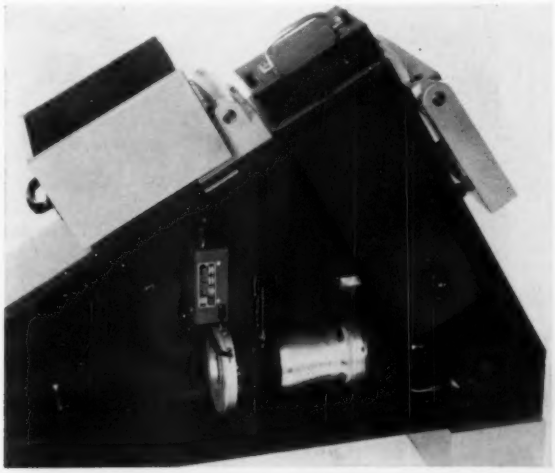

Fig. 17. Armor-plate assembly in sweeping-image research camera.

The work was done by the Jessop Steel Co., which manufactures the special steel used and is familiar with the required heat treatment.

Figure 17 shows this assembly installed in the camera. The latter has its side removed to expose to view the interior armor plating. The exterior cassette hood and its yoke retainer are seen rotated to the open positions. At the right of the photograph is the box insert which fits inside the camera to surround both the rotating mirror and the optical paths between the relay lens and the film. The relay lens is so thick that it will act as an armor plate where it penetrates the box. At the top of the photograph is the film cassette covering the open end of the interior armor box. At the left is the hinged armor hood. In the closed position, the hood is rotated to cover the cassette and overlap the interior box on three sides to prevent the escape of fragments in the event of a mirror explosion. The extra thickness of the body casting on the fourth side of the camera adequately guards the small lateral slit opening on that side. At the upper right is the heavy steel hinged hood-retainer yoke in the open position. (The hood is shown closed in Fig. 6.) Since the armor assembly has been constructed as an accessory, it can also be added to a previously constructed camera. It impedes the work of the operator only slightly.

Conclusion

The list of successful new features incorporated into the earlier model of this camera when it was adapted for use in a wide variety of explosive-research problems includes: (1) a long bed with camera and lens mounts adjustable over its full length; (2) an electric focusing mount with demountable lenses and a remote control to facilitate adjustment over the long distances involved; (3) a large kit of field lenses with a demountable field-lens holder for use with a full range of objective lenses; (4) a slit holder for use with a variety of slit types, along with a view-finder at the final image; (5) a projector to image a bright-line slit at the object; (6) a precision corrector-lens mount for more accurate setting of the position of the corrector lens; (7) a sweeping-image viewer for determining the optimum corrector-lens position; and (8) an armor plating to safeguard personnel in the vicinity of the operating camera. Further information about these improved sweeping-image camera accessories is available from the author.*

The improvements listed above save time and simplify procedure in changing and realigning the optical elements needed for successive explosive-research projects, especially when the image magnification is unity or greater.

Acknowledgments

This camera's versatility has in large part resulted from requirements and/or suggestions made by E. A. Igel, R. J. Reithel, Saul Skolnick, J. H. Blackburn, L. B. Seely and Larry Weintraub. The designs for the new accessories were drawn by E. A. Igel, who also supervised the construction and testing of two of these cameras. Thomas E. Deem gave diligent and painstaking attention to fitting and assembling the parts. Thanks also to W. E. Braun and W. J. Wynne for precise machining of the component parts, to Charles G. Phelps for polishing the rotating mirrors and to C. C. Cummings and C. A. Lehman for assistance in preparing the drawings used for illustrating this paper.

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2. E. A. Igel and T. E. Deem, "The manufacture of shadowgraph slits by metal evaporation," *J. Opt. Soc. Am., 50:* 394–395, 1960.
3. Berlyn Brixner, "Measurement and correction of astigmatic images in rotating-mirror sweeping-image cameras," *Proc. 3rd International Congress on High-Speed Photography*, Butterworths Scientific Publications, 88 Kingsway, London W.C.2; in U.S., Academic Press, 111 Fifth Ave., New York 3, 1957, pp. 319–323.

* Engineering drawings are available at nominal cost from U. S. Atomic Energy Commission, Technical Information Service, P.O. Box 62, Oak Ridge, Tenn.

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standards and recommended practices

Two American Standards Approved

The American Standards Association, on February 8, 1961, approved as American Standards the following:

PH22.118–1961, Dimensions for 65mm Motion-Picture Film, KS-1870

PH22.119-1961, Dimensions for 70mm Motion-Picture Film, Perforated 65mm, KS-1870.

Approved by the Society's Film Dimensions and Standards Committees and ASA Sectional Committee PH22, the standards do not differ from the proposals published for trial and comment in the December 1959 *Journal*.

Copies of the standards may be obtained from the American Standards Association, Incorporated, 10 East 40 Street, New York 16, N. Y., at a nominal cost.

American Standard

Dimensions for 65mm Motion-Picture Film, KS-1870

ASA
Reg. U.S. Pat. Off.

PH22.118-1961

*UDC 778.5.771.523.531.7

1. Scope

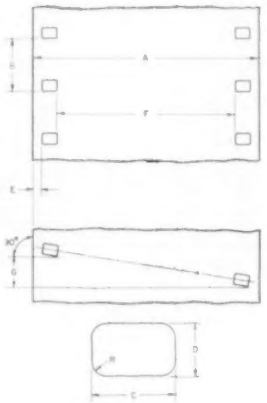
1.1 This standard specifies the cutting and perforating dimensions of 65mm motion-picture film.

2. Dimensions

2.1 The dimensions shall be as given in the diagram and table.

2.2 These dimensions apply to material immediately after cutting and perforating.

2.3 Dimension L represents the length of any 100 consecutive pitch intervals.



Dimensions	Inches	Millimeters
A Film width	2.558 ± 0.002	64.97 ± 0.05
B Length pitch	0.1870 ± 0.0005	4.750 ± 0.013
C Perforation width	0.1100 ± 0.0004	2.794 ± 0.010
D Perforation height	0.0780 ± 0.0004	1.981 ± 0.010
E Edge to perforation	0.117 ± 0.003	2.95 ± 0.08
F Width between perforations	2.104 ± 0.003	53.44 ± 0.08
G Perforation skewness	0.002 max	0.05 max
L Length pitch (100 consecutive pitch intervals)	18.700 ± 0.015	474.98 ± 0.38
R Radius of perforation fillet	0.020 ± 0.001	0.51 ± 0.03

NOTES

1. The title of this standard was established by the application of a nomenclature system developed for all film dimension standards: Each title provides an indication of the film width, the perforation shape (BH, KS, DH or CS) or the number of rows of perforations (1R, 2R or 4R), depending upon which is the significant factor, and the perforation pitch without the decimal point.

2. The dimensions in the inch system are the fundamental standard. The dimensions in the metric system are practical approximations based on American Standard Inch-Millimeter Conversion for Industrial Use, B48.1-1933, reaffirmed in 1947, providing a conversion factor of 1 inch = 25.4 millimeters.

Approved February 8, 1961, by the American Standards Association, Incorporated
Sponsor: Society of Motion Picture and Television Engineers

*Universal Decimal Classification

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Printed in U.S.A.
ASA X3.M63-60

APPENDIXES

(These Appendixes are not a part of American Standard Dimensions for 65mm Motion-Picture Film, KS-1870, PH22.118-1961, but are included to facilitate its use.)

APPENDIX 1

The dimensions given in this standard represent the practice of film manufacturers in that the dimensions and tolerances are for film immediately after perforation. The punches and dies themselves are made to tolerances considerably smaller than those given, but since film is a plastic material, the dimensions of the slit and perforated film never agree exactly with the dimensions of the slitters, punches and dies. Film can shrink or swell due to loss or gain in moisture content or can shrink due to loss of solvent. These changes invariably result in changes in the dimensions during the life of the film. The change is generally uniform throughout a roll.

APPENDIX 2

The uniformity of pitch, margin and hole size (Dimensions B, C, D and E) is an important variable affecting steadiness. Variations in these dimensions, from roll to roll, are of little significance compared to variations from one sprocket hole to the next. Actually it is the maximum variation from one sprocket hole to the next within any small group of consecutive perforations that is important.

APPENDIX 3

Film of this size is generally used as a camera negative. There are two advantages in using this larger size. One is the possibility of producing large prints by contact printing for exhibition in special theaters designed to provide the audience with a large viewing angle. The other purpose is to serve as an original from which 35mm prints can be produced by reduction with less grain and better definition than is obtained by making contact prints from 35mm negatives.

Prints may be made on 70mm film. The appropriate film is described in American Standard Dimensions for 70mm Motion-Picture Film, Perforated 65mm, KS-1870, PH22.119-1961. Note that the 70mm film used with 65mm negative differs in its dimensions from the two earlier films described by American Standard Dimensions for 70mm Unperforated and Perforated Film for Cameras Other Than Motion-Picture Cameras, PH1.20-1956, Type I and Type II. The perforations of the related 70mm film have the same size and pitch as those described by PH1.20-1956, Type II, but the margin and distance between perforations are different. Consequently Dimension F is the same in both the 65mm film, KS-1870 and the 70mm film, perforated 65mm, KS-1870. The increased space provided by a larger margin E is used to make room for magnetic soundtracks.

Note that the image usually placed on this film is five pitches high. The manufacture of the film is based on this idea and best results accrue from using this format. The pitch of the negative is nominal since the printing of film of this size is currently done by the use of step printers.

American Standard

Dimensions for 70mm Motion-Picture Film, Perforated 65mm, KS-1870

ASA
Reg. U.S. Pat. Off.
PH22.119-1961

*UDC 778.5.771.323.531.7

1. Scope

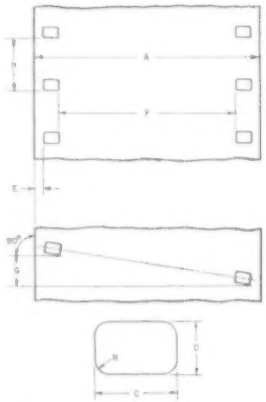
1.1 This standard specifies the dimensions of 70mm motion-picture film, perforated 65mm.

2. Dimensions

2.1 The dimensions shall be as given in the diagram and table.

2.2 These dimensions apply to material immediately after cutting and perforating.

2.3 Dimension L represents the length of any 100 consecutive pitch intervals.



Dimensions	Inches	Millimeters
A Film width	2.754 ± 0.002	69.95 ± 0.05
B Length pitch	0.1870 ± 0.0005	4.750 ± 0.013
C Perforation width	0.1100 ± 0.0004	2.794 ± 0.010
D Perforation height	0.0780 ± 0.0004	1.981 ± 0.010
E Edge to perforation	0.215 ± 0.003	5.46 ± 0.08
F Width between perforations	2.104 ± 0.003	53.44 ± 0.08
G Perforation skewness	0.002 max	0.05 max
L Length pitch (100 consecutive pitch intervals)	18.700 ± 0.015	474.98 ± 0.38
R Radius of perforation fillet	0.020 ± 0.001	0.51 ± 0.03

NOTES

1. The title of this standard was established by the application of a nomenclature system developed for all film dimension standards: Each title provides an indication of the film width, the perforation shape (BH, KS, DH or CS) or the number of rows of perforations (1R, 2R or 4R), depending upon which is the significant factor, and the perforation pitch without the decimal point.

2. The dimensions in the inch system are the fundamental standard. The dimensions in the metric system are practical approximations based on American Standard Inch-Millimeter Conversion for Industrial Use, B48.1-1933, reaffirmed in 1947, providing a conversion factor of 1 inch = 25.4 millimeters.

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ASA5, Mod. 10

APPENDIXES

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APPENDIX 3

Film described in this standard is used in making prints from 65mm film described in American Standard Dimensions for 65mm Motion-Picture Film, KS-1870, PH22.118-1961. Note that this film differs from the other 70mm films described in American Standard Dimensions for 70mm Unperforated and Perforated Film for Cameras Other Than Motion-Picture Cameras, PH1.20-1956, Types I and II.

Society of Motion Picture and Television Engineers

Medieval architecture in the New World, Toronto's famous Casa Loma.

89th Semiannual Convention and Exhibit

Advance Papers Program and International Equipment Exhibit

Hotel King Edward Sheraton, Toronto, Canada, May 7-12

Rodger J. Ross, Program Chairman, 89th Convention.

The publication of the Advance Program, together with the last-minute pre-Convention announcements, represents an important and most dynamic phase of Convention planning. Every item of information relating to the forthcoming Convention has been reported by the Arrangements Committee in condensed and convenient form for the membership. Announcements in the *Journal* present detailed accounts of pre-Convention activities, together with a few highlights of the Convention City and "fun" plans. The Postal Announcement with Hotel Reservation card and information on hotel rates, together with the outline of sessions and other items, should by now have been received by all members.

This Advance Program tells its own story of top-notch papers of unusual significance which not only illustrate the broad interests of the Society on a worldwide basis, but also point to developing trends within the industry. A few changes may be made in this Program before, or even during, the Convention; but the Advance Program is as complete and accurate as it can be at this time.

The "8mm trend" is being carefully watched by industry leaders. Speculation as to its lasting importance has given way to intense interest in its possibilities for educational, industrial and other applications. This subject occupies two entire sessions — Tuesday morning and afternoon.

Other papers of considerably more than routine interest will be presented at the two Laboratory Practice sessions scheduled for Thursday morning and afternoon. Two papers will give detailed descriptions of the new viscous coating process. The papers (Parts I and II of the overall subject of "Rapid Processing of Motion-Picture Film by the Application of Viscous Coatings") describe (Pt. I) the principles of development with viscous coatings, and (Pt. II) a new machine called the Eastman Viscomat Processor, Model 10P. This machine uses viscous solutions applied at 125 F to process 16mm film at a rate of 36 ft/min. One frame is completely developed and dried in one minute. The paper (Pt. I) on "Viscous Processing of Motion-Picture Film by the Application of Viscous Coatings," is by George E. Cummins, John R. Turner and Robert J. Wilson. Part II, "A Machine for the Rapid Processing of Motion-Picture Film," is by Paul A. Hermle and Harold D. Lowry. The authors are all with Eastman Kodak Co.

Altogether, a dozen papers are scheduled for the Laboratory Practice Sessions, many of them of extraordinary merit.

The Wednesday Afternoon (2 : 00 P.M.) session on Sound Recording and Reproduction is being held concurrently with the Equipment Papers and Demonstrations.

A special guest for the Cocktail Party and Banquet will be Mrs. Ellen Fairclough, Canada's Minister of Citizenship and Immigration.

Reservations for the banquet, at $12.50 per person, should be sent, the earlier the better, directly to the Banquet Chairman: Arthur Chetwynd, Chetwynd Films Ltd., 21 Grenville St., Toronto. Checks should accompany orders.

For the Ladies

Plans for the ladies have as one of the main events a trip to Niagara Falls; there are also various tours, teas and other activities. It is more than likely that many of the ladies will regard the shopping facilities as the main attraction and will succumb to the temptation of handloomed woolens, authentic English bone china and other useful and beautiful souvenirs of Canada.

Unscheduled leisure time activities might well include a look at the many historic sites in and around Toronto. Each Convention City has its own special character and its own list of attractions. Toronto has been the site of many exciting historical events (a few of them noted in the February *Journal* on p. 115), and its present, while far removed from frontier adventure, is no less exciting.

A remarkable roster of short subject films was already in hand and listed in the November *Journal*, page 826. The Program at the Convention will show these arranged at the opening of Sessions.

ABSTRACT OF LADIES PROGRAM

Sunday Afternoon — Registration
Evening — Buffet Supper and pre-release feature film, courtesy SMPTE
Monday Morning — Registration
Noon — Get-Together Luncheon
Afternoon — Ladies get-acquainted tea at the King Edward Sheraton Hotel, courtesy of Photo Importing Agencies Ltd.
Tuesday Morning — Trip to Niagara Falls
Lunch — Brock Hotel, Niagara Falls, courtesy of Minnesota Mining and Manufacturing of Canada Ltd. Return at 5:30 P.M.
Evening — Guests of C.B.C. "Front Page Challenge" programme
Wednesday Morning — Open, shopping guide and transportation available
Afternoon — Open
Evening — Cocktail Party, courtesy of National Film Board of Canada. Banquet
Thursday Morning — Open
Afternoon — Tea and tour of Casa Loma, courtesy of Alex Clark Equipment Co. Ltd.
Evening — Open
Friday — Open, tickets available for C.B.C. programme

The Ladies Lounge will be open each day during the technical sessions for your convenience.

The Tentative Schedule of Committee Meetings, appears later on this page. The Directory of Equipment Exhibits will be found on pages 211–218.

The Association of Motion Picture Producers and Laboratories of Canada has tentative plans for a Conference for May 12, and also other activities in conjunction with the Society's Convention.

The Canadian Film Institute plans to present the Canadian Film Awards at the King Edward Sheraton Hotel on Saturday, May 13.

The social center of the Convention for refreshment and conversation, the Coffee Club, will be under the sponsorship of Canadian Kodak Ltd., of Toronto.

Outline of Program

Sunday

12:00–6:00 Registration
7:30 Buffet
9:15 Film Premiere

Monday

9:00 Registration
9:30 Cinematography
12:15 Get-Together Luncheon, Guest Speaker: J. J. Fitzgibbons, Sr.
2:30 Image Forming Systems, Instrumentation and High-Speed Photography
7:30 Films and Television in Education

Tuesday

9:00 New Developments in 8 mm
2:00 New Developments in 8 mm
7:30 Film Projection and Television Film

Wednesday

9:00 Sound Recording and Reproduction
2:00 CONCURRENT SESSIONS
Sound Recording and Reproduction
Equipment Papers and Demonstrations

Thursday

9:30 Laboratory Practices
2:00 Laboratory Practices
7:30 Television Recording

Friday

9:00 Television Studio Practices and Station Operation
2:00 Television Station Operation and Equipment

Tentative Schedule of Committee Meetings

Tuesday, May 9

10:00 A.M. Papers Committee
11:00 A.M. Board of Editors
12:15 P.M. Editorial Luncheon
2:00 P.M. Publications Advisory Committee

Thursday, May 11

8:00 P.M. Association of Cinema Laboratories Board Meeting

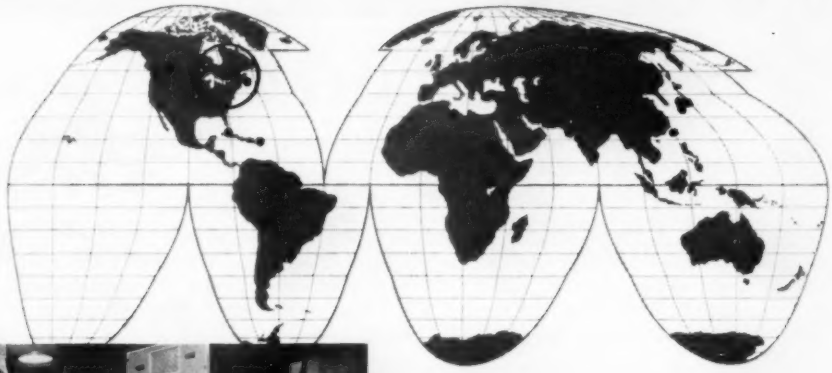
Friday, May 12

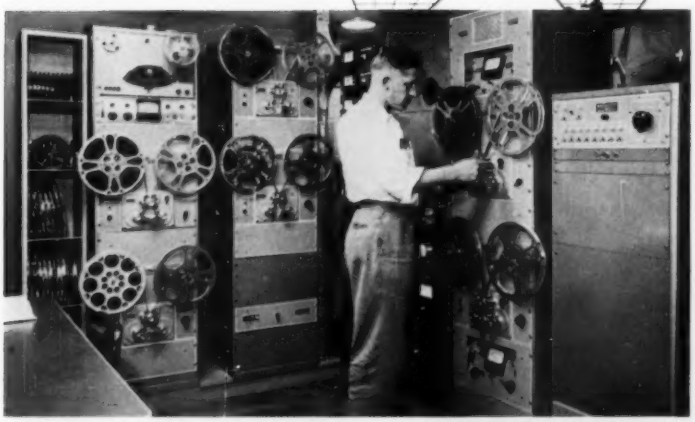
Association of Cinema Laboratories Meetings
8:00 A.M. Pre-Breakfast Meeting
9:00 A.M. Voting Members
11:30 A.M. Voting and Assoc. Members
2:00 P.M. Committee Meetings
4:00 P.M. General Meeting

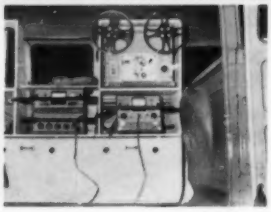
Engineering Committees which will meet during the week are tentatively listed below. The final schedule will appear in the Convention Program. All Committee Members will also be notified by mail.

Color
Film Dimensions
Film Projection Practice
Instrumentation and High-Speed Photography
Laboratory Practice
Screen Brightness
16 & 8 mm Sound
Standards

AROUND THE WORLD WITH MAGNASYNC





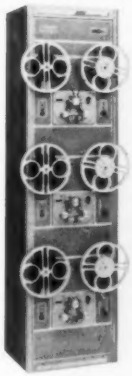


toronto *(ontario, canada)*

Cinesound, Limited, one of the most completely equipped sound recording and mixing facilities in Canada, has found Magnasync the perfect "systems" solution in meeting the demands of the great motion picture and industrial expansion prevalent in Canada.

A section of the Cinesound control room is shown in main photo at left, with sound engineer Fred Sengmueller operating one of the famous Model 602 dubbers. The Magnasync-equipped mobile unit is shown on location at Milliken Lakes Mines, Elliott Lake, Ontario, during the Showcase Production filming of "Shaft Sinkers".

For the development of a complete Magnasync-Magnaphonic sound system Cinesound engineers installed Magnasync modular electrical interlock components for transfer work, assembly and magnetic mixing to assure their clients of the highest quality, reliability and economy.



Numbered among the famous Canadian firms using Magnasync are:

Royal Canadian Air Force	Canada	Government of the Province of Alberta, Edmonton	
Canadian Broadcasting Corporation . .	Canada	University of British Columbia . .	Vancouver
Vantel Broadcasting	Vancouver	Master Film Studios	Calgary
National Film Board of Canada . .	Montreal	Cinesound Ltd.	Toronto
Briston Films Inc.	Montreal	Eastern Film Laboratories	Halifax
Trans-Canada Films Ltd.	Vancouver	Michael J. Sym Studios	Winnipeg

MAGNASYNC — Magnaphonic SOUND SYSTEM

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International leaders in the design and manufacture of quality magnetic recording systems

Magnasync Studio Equipment Division Dealers:

CHICAGO: Zenith Cinema Service, Inc.; Behrend Cine Corp.; **LOS ANGELES:** Birns & Sawyer Cine Equipment; **NEW YORK:** Camera Equipment Co.; **SOUTH AFRICA:** Johannesburg, Photo Agencies Pty. Ltd.; **AUSTRALIA:** Sydney, New South Wales, Sixteen Millimetre Australia Pty. Ltd.; **BOLIVIA:** La Paz, Casa Kavlin; **BRAZIL:** Rio De Janeiro, Mesbla, S.A.; **BURMA:** Rangoon, G. K. Theatre Supply Co., Ltd.; **CANADA:** Toronto, Ontario, Alex L. Clark, Ltd.; **DENMARK:** Copenhagen, Kinovox Electric Corp.; **ENGLAND:** London, W-1, Delane Lea Processes, Ltd.; **FRANCE:** Paris, Brockless-Simplex S.A.; **GREECE:** Athens, Christos Axarlis; **HONGKONG:** Supreme Trading Co.; **INDIA:** Bombay, Kine Engineers; **ITALY:** Rome, Reportfilm, di J. M. Schuller, S.R.L.; **JAPAN:** Tokyo, J. Osawa & Co., Ltd.; **NEW ZEALAND:** Auckland, Kerridge Odeon Industries; **PAKISTAN:** Karachi 3, Film Factors Ltd.; **SOUTH RHODESIA:** Salisbury, William Over & Co. Pvt. Ltd.; **THAILAND:** Bangkok, G. Simon Radio Co., Ltd.

See our equipment at the SMPTE Convention in Toronto, Canada, May 7–12, 1961

89th Convention—Advance Program

King Edward Sheraton • May 7–12

Theme: International Achievements in Motion Pictures and Television

This program is as complete and accurate as possible at press time — but there may be errors and there probably will be some changes for the Final Program. If attendance at a session is now being planned for only a specific paper or two, members are advised to inquire during the week before the Convention by telephoning to SMPTE Headquarters in New York (LOngacre 5-0172) or to Rodger J. Ross, Canadian Broadcasting Corp., 354 Jarvis St., Toronto, Ont. (telephone Walnut 5-3311, Local 4504).

SUNDAY—MAY 7

12:00–6:00 Registration

MONDAY—MAY 8

9:00 Registration

9:30 CINEMATOGRAPHY

Some Psychological Aspects of Motion-Picture Montage

JOHN R. GREGORY, *Boeing Airplane Co., Vashon, Wash.*

A psychological theory which explains how an edited motion-picture film or a TV program communicates would be of value to the communications theorist and possibly to the practicing communicator. A model of the process may be based on the grammar of modern English; psychological theory may be found which underlies both English grammar and visual editing. Research with specially structured film-clips yielded test data relating to the theory.

Effect Techniques as an Aid to Low-Budget Production

WALLY GENTLEMAN, *National Film Board, Montreal, Que.*

This paper describes the application of various feature film techniques, such as process projection, traveling mattes, painted mattes, model and miniature, and optical printing procedures, to low-budget production under the organization of the National Film Board of Canada. The planning and development of the various processes from conception to completion is dealt with. The integration of varied skills and crafts is considered and explained.

Novel Technical Means of Expression in the Motion-Picture Art

FRANTISEK PILAT, *Czechoslovak Film Corp., Praha, Czechoslovakia*

Technologies, recently developed in Czechoslovakia include (1) Polyecran, a system for simultaneous projection on three or more screens disposed in space in various ways. Sections of motion pictures or diapositives are projected onto the screens. The sound accompaniment is directional and stereophonic. The operation is automatized. (2) Laterna Magica is a combination of projected films and diapositives, as well as sound reproduction with the performance of live actors. To this end special systems of technical equipment have been developed.

Characteristic Features of Czechoslovak Motion-Picture Technique

VILEM TARAHA, *Czechoslovak Film Corp., Praha, Czechoslovakia*

The particular results achieved in Czechoslovakia in motion-picture production, laboratory processing and projection are related to characteristic features of some new technologies and the newly developed technical film equipment. The importance of international standards is stressed.

Simulated Night Photography Using Color Reversal Films

GEORGE T. KEENE, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*

The current methods of obtaining night effects in daylight photography are reviewed critically, and a number of possible improvements are explored. An original given two stops overexposure and printed using a printing master is shown to give a desirable reduction of tone scale, less color saturation, and a more realistic night effect. The required compromise between realism and tone compression is explained. Night scenes photographed using artificial lights and moonlight are discussed briefly.

The Super Technirama 70 Process

DONALD NICHOLSON, *Technicolor Corp., Hollywood*

The Technicolor Super Technirama 70 print process is described and illustrated. Attention is given to the camera and printing equipment used. The combination of large-area negative and large-area positive produces a screen result of outstanding quality. In addition, excellent prints may be made in a variety of aspect ratios on 35mm and 16mm print films. This flexibility is designed to meet today's exhibition requirements.

12:15 Get-Together Luncheon
Guest Speaker—"What's New in Exhibition"

J. J. FITZGIBBONS, Sr., Vice-President and Director, Trans Canada Telemeter, Ltd.

MONDAY AFTERNOON

2:30 IMAGE FORMING SYSTEMS

INSTRUMENTATION AND HIGH-SPEED PHOTOGRAPHY

An Objective Method for Rating Picture Sharpness

EDWARD M. CRANE, *Research Laboratories, Eastman Kodak Co., Rochester, N.Y.*

At a recent convention Fred H. Perrin reviewed the history and theory of sine-wave response determination (*Journal 69*, 151–156 and 239–249, 1960). The significance and usefulness of sine-wave response can also be empirically demonstrated. The effects of the printer on picture sharpness and the relative sharpness of various professional motion-picture films and release prints can be quantitatively described. An empirical approach to evaluation leads to a proposed objective sharpness rating.

THE MARK IV CAMERA CHAIN

EXPERIENCE COUNTS

Marconi's pioneered the use of the 4½ inch Image Orthicon Camera using the tube developed by their associates, the English Electric Valve Company. Marconi's have amassed more 'know-how' on the use of the 4½ inch Image Orthicon than any other manufacturer.

OVER 600 MARCONI IMAGE ORTHICON CAMERA CHAINS HAVE BEEN SOLD THROUGHOUT THE WORLD

BD 863 MARK IV IMAGE ORTHICON CAMERA

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FIRST CLASS PICTURE QUALITY
The 4½ inch Image Orthicon tube gives a picture quality substantially better than any other type or size.

LIGHT AND COMPACT
By reducing and simplifying the camera electronics its weight has been held below 100 lb. and its size made correspondingly small.

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G4M

Detection of Binary States in the Presence of Noise

P. L. P. DILLON and J. C. MARCHANT, *Research Laboratories, Eastman Kodak Co., Rochester, N.Y.*

On the basis of an ideal physical detector, a general expression is derived for the probability of detecting binary states in the presence of noise. It is shown that this probability can be maximized for a given signal-to-noise ratio by the correct choice of the various parameters involved. The analysis is applied to the problem of detecting binary-coded information in a photographic film and the validity of the analysis is demonstrated experimentally.

Optimizing Image-Converter Camera Performance

GEORGE L. CLARK, *Space Technology Laboratories, Inc., El Segundo, Calif.*

A number of factors affecting the performance of an ultra-high-speed image-converter camera have been investigated. Many of these factors are associated with the image-converter tube, such as electron optical resolution, photocathode resistance, grid circuit resonance, and distortion caused by space charge. The design of the optical system involves choices of lens apertures, fields of view and resolution. Since the factors are interdependent, each one cannot be optimized by itself, but must be considered as part of the system.

Electrostatic Printing and Display Techniques, Using Charactron and Line-Scan Tubes

C. D. MILLER and K. MORGAN, *Information Technology Div., General Dynamics/Electronics, San Diego, Calif.*

A family of computer readout, display, facsimile and digital communication equipment has been developed using electrostatic images formed by high-precision Charactron and line-scan techniques. A comprehensive analysis of problems is given together with solutions encountered in the design of the equipment. Various applications of electrostatic images for the recording and retrieval of alphanumeric, pictorial or graphic data are discussed. Detailed attention is given to some of the basic problems involved in the transfer of cathode-ray-tube images to the recording surface.

Principle and Proof of a Simultaneous-Writing High-Speed Streak and Framing Camera Concept

L. R. TEEPLE, JR., *Beckman & Whitley, Inc., San Carlos, Calif.*

A simple principle of a simultaneous recording of both streak and framing record of the same event makes possible direct separate frame observation during streak recording of high-speed events. The system permits progressive, full-frame identification from the same observation point of phenomena often difficult to identify with certainty on a streak record alone.

Long-Focal-Length Sweep Camera for Backlighted Exploding Wire Photographs

H. S. BURDEN, D. D. SHEAR and F. D. BENNETT, *Ballistic Research Laboratories, Aberdeen Proving Ground, Md.*

A 15-nanosecond-resolution streak camera for photographing exploding wires uses a simple, intense backlighting source and a slow lens. 10-microsecond views of the explosion unobscured by its characteristic short, intense flash are obtained. Components of the camera, light source, and synchronizing circuits are detailed. Formulas for the effective lens speed and for the instantaneous sweep-speed of the finite thickness rotating mirror are given. The time resolution is considered. Typical photographs are displayed.

Factors Limiting the Accuracy of Data Acquired by Photographic Instrumentation

L. E. DAVIDSON, *Ordnance Corps, Aberdeen Proving Ground, Md.*

The accuracy of data obtained by photographic instrumentation is affected by many factors. Some are controllable, others are unavoidable. At Development and Proof Services, Aberdeen Proving Ground, Md., studies have been made to improve the accuracies of data obtained photographically during weapons tests. Techniques are discussed for field calibration of equipment, exacting operational methods and use of high-speed computers during data analysis, to eliminate altogether or minimize effects which tend to produce data inaccuracies.

Research and Development of Optical Tracking Methods and Instrumentation at the Ballistic Research Laboratories

DIRK REUYL and WALTER CARRION, *Ballistic Research Laboratories, Aberdeen Proving Ground, Md.*

Methods and instrumentation for the determination of missile trajectory, attitude and warhead functioning as well as target intercept are discussed. Detailed descriptions are given of the IGOR, SMT and RT-2 systems. The RT-2, a large-aperture, wide-field, precision tracking telescope with real-time shaft angle readout is the latest telescope developed by BRL. The applicability of these instrument systems to other problems is shown, particularly in the field of space probe and satellite research

MONDAY EVENING

7:30 FILMS AND TELEVISION IN EDUCATION

A New Specialized Training Course for Television Technicians

D. E. C. FOWLER and N. R. OLDING, *Canadian Broadcasting Corp., Montreal, Que.*

A survey within CBC indicated that an improvement in operations was possible, particularly in certain technical areas. To achieve this, a small technical training center was established and it is now capable of training the student in logical trouble-shooting techniques. Lectures are supplemented by practical training in the required subjects, using overhead visual projectors and electronic building blocks. Experience gained by the trainee in this manner is applied directly toward the rapid location and correction of faults in technical equipment. A new approach to technical maintenance training is discussed in detail.

Successful Communication

CLIFFORD BROWN, *Canadian Marconi Co., Montreal, Que.*

A comparison is made between the concepts of the engineer and the educationist in the field of communication. The mass media are seen as the conjunction of two philosophies, which must now be linked by a bridge of semantics and symbology. Didactic and intuitive approaches to learning are considered in engineers' terminology, and the concept of the "eductive interface" is postulated. Video-tape illustration of "A New Way To Teach Mathematics" supports the thesis.

Teacher-Student Communication

H. J. SCHLAFLY, *TelePrompTer Corp., New York*

Transmission of knowledge and ideas between the teacher and the student is greatly augmented by the integrated and planned use of modern communication tools. This type of system aid to the teacher is discussed together with working examples from both government and university level installations.

Technical Aspects of an Educational TV and Radio Station

J. L. MYLES, *WGBH-TV, Cambridge, Mass.*

Engineering and production achievements in the educational field of broadcasting are described, with emphasis on the improvement of station operating practices through local workshop seminars for production and engineering groups. Also included will be technical requirements of NET, of which WGBH, Boston, is an affiliate, which are in accordance with the SMPTE recommended practices and proposed practices and ASA standards.

The Technical Aspects of Educational Television in Detroit

JOHN F. X. BROWNE, Jr., *Detroit Educational Television Foundation, Detroit*

Educational television in Detroit has grown from a small part-time broadcast station to one of the largest educational television operations in the United States. The technical aspects of a six-studio television operation producing live programs for broadcast, two closed-circuit systems, national and local video-tape distribution, and airborne television involve almost every technical phase of television. Production and distribution of programs, and the compatibility and interchangeability of video-tape recordings in this complex operation require a high degree of flexibility but rigid technical standards are required to maintain technical quality.

TUESDAY MORNING—MAY 9

9:00 NEW DEVELOPMENTS IN 8MM — 1

The Future Role of 8mm Sound Film

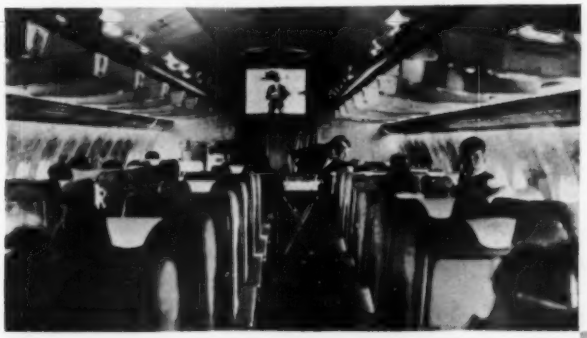
JOHN FLORY, *Eastman Kodak Co., Rochester, N.Y.*

8mm sound film, "another milestone in the communications revolution," may extend the boundaries of the motion-picture industry just as paperbacks have extended the field of publishing. Some major technical and economic obstacles must be overcome before the potential of 8mm for home entertainment, community service, religion, medicine, science, business and industry, and education can be fully realized.

THROUGHOUT THE WORLD
REEVESOUND

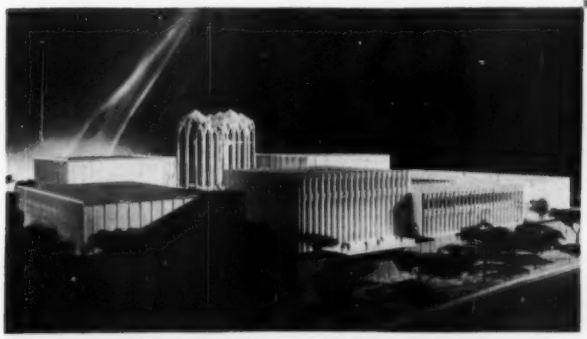
creates specialized motion picture systems to meet the most specialized needs!

From Seattle to Pakistan, on the ground or in the air, wherever the problem, whatever the need, Reevesound invariably comes up with the perfect answer. No job's too tough, no project inconceivable. And Reevesound does it all! Design, layout, manufacture, building, installation, operation—Reevesound specialists take every phase in tow to create a system tailored for your needs. Here are some Reevesound installations now making news throughout the world!



Motion Pictures while you fly!
Jet airliners will show full length features while in flight . . . thanks to Reevesound. This advanced system incorporates special screens and equipment with crucial safety devices that meet highest airline and Government standards. An aeronautic first . . . another Reevesound success, engineered for Inflight Motion Pictures, Inc.

Pakistan gets a studio!
A motion picture production center for the government of Pakistan! Reevesound planned and provided the complete design, equipment, technical facilities—and installed them. In addition, Reevesound supplied personnel and training to get the studio on its feet!



Breaking the presentation barrier!
The Federal Science Pavilion at the Century 21 Exposition in Seattle will feature a revolutionary multiple image projection system (seven projectors are employed). Designed especially by Reevesound for the U.S. Department of Commerce. The system will show a highly imaginative film presentation created by famed designers Charles and Ray Eames who worked closely with Reevesound engineers.

Other recent Reevesound systems included the U.S. Exposition, Moscow 1959; Latin American Atomic Energy Exhibition, 1960. If you need a special motion picture system, but think it can't be done—call Reevesound.

REEVESOUND Company, Inc. ■ 35-54 36th Street, Long Island City 6, N.Y. ■ A subsidiary of Reeves Soundcraft Corp.

Early 8mm Sound Developments

WM. D. HEDDEN and KENNETH B. CURTIS, *Calvin Productions Inc., Kansas City, Mo.*

Recently much interest and activity has been shown in the use of 8mm films. Although this interest in the 8mm field has fluorished recently after the introduction of several 8mm sound projectors, much research and development had been done in the past by those interested in 8mm films. This paper presents an historical resume of the work of the late Lloyd Thompson and some of his early developments. Particular attention is given to the sound projection equipment he introduced and some of the film procedures that he utilized to make release prints.

8mm Magnetic Sound Equipment Round-Up

EYRE BRANCH, *Noel Enterprises, Hartsdale, N.Y.*

Recent developments in 8mm sound projectors, cameras and magnetic striping equipment are reviewed. Types of projectors described and illustrated include (a) built-in sound couplers operating with tape recorders; (b) conversion to sound by addition of separate recording and playback heads; and (c) complete 8mm magnetic sound recording and playback units. A recently developed 8mm sound camera is described, also new equipment ranging from the do-it-yourself hand-operated magnetic striper to the elaborate laboratory model. The growing interest in this medium of communication is evaluated.

8mm Magnetic Sound Film in Audio-Visual Applications

R. G. HENNESSEY, *Industrial Products Div., Fairchild Camera & Instrument Corp., Yonkers, N.Y.*

There are properties of 8mm magnetic film which permit exceptional life as well as initial economy in adaptation. Equipment advantages in comparison to previously existing machines are presented. Results of life test runs are presented as well as results of other tests. Various applications of 8mm equipment are described in detail.

An Educator Looks at 8mm Sound Film

LOUIS FORSDALE, *Horace Mann–Lincoln Institute of School Experimentation, Teachers College, Columbia Univ., New York*

The development of 8mm sound film suggests important advances for film in education, including increased utilization resulting from decentralization of film libraries, increased use of film by small groups and individual learners, expanded lists of titles, new uses in research, and exploitation of local production possibilities. Many of these advances are critically dependent, however, on the availability of vastly simpler, lighter and cheaper projectors and viewers, and on improvements in 8mm sound cameras.

8mm and the Classroom Film Library — Potentials and Requirements

STEVE KNUDSEN, *Iowa State Univ., Ames, Iowa*

Our present educational usage pattern for film involves film rentals, special projection rooms, and passed-around projectors. Can 8mm serve as the agent to change this to a pattern in which an adequate library of films and the necessary projection facilities remain in and are an integral part of the classroom? If so, what will be the scope of such a shift? What are the requirements before such a shift can take place?

An Endless-Loop Magazine for Projection of 8mm Film; Silent and Magnetic Sound

RICHARD C. GEARHART, *Cousino Electronics Corp., Toledo, Ohio*

The advent and promising commercial future of 8mm films has stimulated development of a simple, inexpensive magazine designed for accessory use with any commercially available 8mm projector, silent or magnetic sound. The magazine is suitable for applications in which both the print and magazine are expendable, such as conventions, window displays and short-term point-of-sale promotions, industrial engineering time studies, etc. Features and operation of the magazine are described and factors affecting film abrasion and breakdown life are discussed.

Rear Projection of 8mm Sound Prints

FRED E. AUFHAUSER, *Vicom Inc., Rochester, N.Y.*

Problems encountered when making enlargements of 8mm are discussed and their solution illustrated by use of the New Vicaudio Sound 8 Projector and the showing of various films. The optical system needed to achieve a clear, brilliant picture is described.

TUESDAY AFTERNOON

2:00 NEW DEVELOPMENTS IN 8MM — 2

New Possibilities in 8mm Projection

WALTER RYBKA, *Paillard Inc., New York*

The new Bolex 18-5 projector for 8mm, permits completely flickerless projection at 18 frames/sec and at a new slow-motion speed of 5 frames/sec, due to a new variable shutter which automatically changes the number of shutter blades, without appreciably changing the screen brightness. The projector is also used in combination with the Bolex Sonorizer for the recording and playing back of magnetic sound on 8mm. The Bolex Sonorizer has an overplay feature which automatically reduces the volume of a recording in order to permit overplaying a second soundtrack.

A Self-Contained Recorder for Motion-Picture Sound

WILLIAM V. STANCIL, *Stancil-Hoffman Corp., Hollywood*

Exciting techniques in motion-picture production now require compact camera and sound equipment. A self-contained, battery-operated and transistorized tape recorder is described which provides synchronization with both spring-driven and motor-driven cameras. The 13-lb recorder may be used in conjunction with 35mm, 16mm or 8mm cameras, and the resultant sound may be transferred to sprocketed film for editing and subsequent release, or it may be synchronized with projectors for double-system viewing.

High-Speed Inspection of Magnetic-Striped Release Prints

BEN KLEINERMAN, *Federal Manufacturing & Engineering Corp., Garden City, N.Y.*

A low-frequency (30-cycle) sine wave is recorded along with the audio when making the release print. This signal may then be picked up during high-speed (400 ft/min) examination of other physical defects. Thyratron-actuated relays stop the machine in the event of a dropout, splice or reduction in signal output level indicating an alteration in the soundtrack. The operator may then start up again at 24 frames/sec and listen for any objectionable erasure or re-recording.

8mm Color Positive Release Prints With Magnetic Sound: A Progress Report

ROBERT A. COLBURN, *Geo. W. Colburn Laboratory, Inc., Chicago*

Silent 8mm color reduction prints were produced almost 25 years ago. Constant improvements in methods and materials led to many commercial uses. Although a paper on 8mm magnetic sound was first presented to the Society in 1947, little progress was apparent until late 1959. The Geo. W. Colburn Laboratory adapted existing equipment and designed and built new equipment to meet the demand for quality 8mm color sound prints in volume at a cost substantially lower than 16mm prints, despite many additional operations involved.

The Manufacture of 8mm Prints at Technicolor

W. E. POHL, *Technicolor Corp., Hollywood*

Methods used at Technicolor for preparation of 8mm magnetic-sound release prints made from 35mm Eastman Color Negative or 16mm Ektachrome source material are discussed.

Developments in Magnetic Striping 8mm Sound Films

EDWARD SCHMIDT, *Reeves Soundcraft Corp., Danbury, Conn.*

The advent of 8mm sound has prompted the design and construction of a single 8mm striping machine for photofinishers, a high-speed 8mm double striping machine for laboratory use and modifications to the standard Model "Z" striping machine. These various equipments are described and experiences on striping large quantities of unexposed double 8mm raw stock are discussed.

Precision Magnetic Striping of 8mm Film

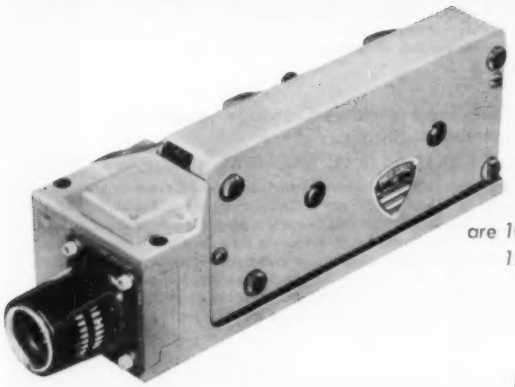
F. J. KOLB, E. M. WEIGEL, R. LOVICK and J. PEER, *Kodak Park Works, Eastman Kodak Co., Rochester, N.Y.*

Magnetic sound recording on 8mm film demands close tolerances on both stripe dimensions and magnetic-audio performance because the system requires a narrow stripe and a low film speed. The requirements of good design of a striping machine are reviewed with particular attention to positive film positioning and stripe placement at the striping point, constant-speed film drive, and minimum film tensions. A coating head and a corresponding high-viscosity magnetic dispersion are described that together define stripe width, thickness and contour. This system has been used by the Eastman Kodak Co. to provide 8mm Sonotrack since May, 1960. Quality control data from this operating experience are reviewed to indicate reasonable production control for the guidance of processing laboratories who may wish to design similar striping systems.

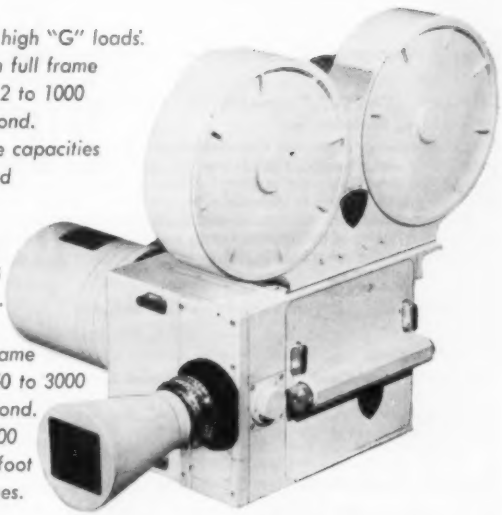
Photo-Sonics, Inc., designed to solve a unique feature — a rotary disc between film and prism — these produce extremely high resolution

PRECISION PHOTOGRAPHIC INSTRUMENTATION

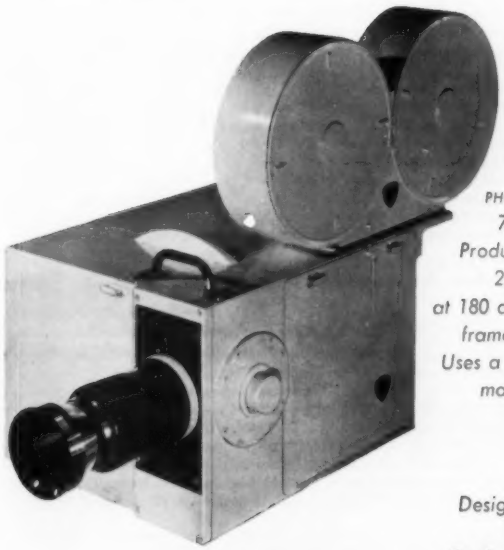
produces a full line of rotary prism cameras *your* instrumentation problems. By the use of shutter located fine cameras pro- sharp pictures with over the entire frame.



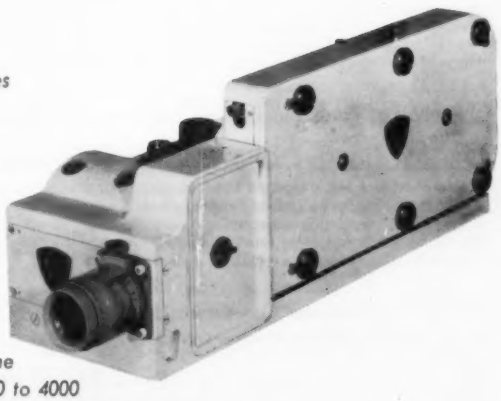
The PHOTO SONICS *16mm-1B . . . Designed for high "G" loads. Produces 16mm full frame pictures at 12 to 1000 frames per second. Film magazine capacities are 100, 200, 400, and 1200 feet.*



The PHOTO-SONICS *35mm-4B . . . Produces 35mm full frame pictures at 250 to 3000 frames per second. Uses 500 and 1000 foot magazines.*



The PHOTO-SONICS *70mm-10B . . . Produces full frame 2.25" x 2.25" pictures at 180 and 360 frames per second. Uses a 400 or 1000 foot magazine.*



The PHOTO-SONICS *16mm-1C . . . Designed for extremely high "G" loads. Produces 16mm full frame pictures at 1000 to 4000 frames per second. Utilizes a 400 foot magazine.*

to solve your photographic instrumentation problems, contact

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8mm Film With Photographic Sound

JOHN A. MAURER, *JM Developments, Inc., New York*

For applications in which very large numbers of prints are required and low cost is important, photographic sound on 8mm offers major advantages, since no striping process is required and the sound can be printed in one operation with the picture. Photographic sound can be as good as magnetic; the belief that it cannot arises only from the general failure of the industry to explore the possibilities of photographic recording. Optimum procedures for the quantity production of high-quality prints are outlined. Sound quality is demonstrated, using an 8mm magnetic projector converted for the reproduction of photographic soundtrack.

TUESDAY EVENING

7:30 FILM PROJECTION AND TELEVISION FILM

Energy Absorption Considerations in Motion-Picture Projection

ERIC A. YAVITZ, *Manufacturing Experiment Div., Eastman Kodak Co., Rochester, N. Y.*

Data on the energy absorption characteristics of color and black-and-white release films are presented. Calculations are made of the relative energy absorbed by these films when projected with a high-intensity carbon arc in conjunction with a silver or dichroic reflector. The results are compared to each other, and their significance and implications are discussed. The spectral distribution of the incident energy and its important bearing upon the performance of color films is reviewed.

The Xenon Light in Film and Television Industry

ALBERT JEKSTE, *Atlantic Films and Electronics, Ltd., St. John's, Newfoundland*

Some of the theories and characteristics of Xenon Light are discussed together with its historical development. There are practical applications in optical systems in motion-picture projection, rear projection, printing machines and sound recording.

Trends in 70mm Projection Equipment

GIOVANNI BOZZI, *c/o Cinemeccanica, Milano, Italy*

The future of 70mm production is largely dependent on the medium-size theaters, so it is imperative that economy of installation be made a primary consideration. Low-priced equipment that permits continuing use of equipment already installed, and compatibility of 70mm and 35mm operations to avoid a third projector operation have been the main goals in the design of the Victoria X, and particularly the new Victoria 8.

A Method of Producing Telecine Test Materials of Specified Density

LESLIE H. HOLMES, *Ryerson Institute of Technology, Toronto, Ont.*

Ten-step staircase test wedges on 2 by 2-in. slides and 16mm film have been manufactured to predetermined density values. A general account is given of a method of correlating subject reflectance with negative density, preparation of flashed paper strips to serve as a master copy and the problems associated with producing a predicted scale of densities.

Vidicon Light-Transfer Characteristics and Film Reproduction

R. G. NEUHAUSER, *Electron Tube Div., Radio Corp. of America, Lancaster, Pa.*

The light-transfer characteristics of the vidicon cannot be used directly to predict light-transfer characteristics of a television-film system. The practice of setting the darkest excursions of the video portion of a TV signal to black level, or cutoff of the TV picture tube, changes the effective light-transfer characteristic of the vidicon. Additional gamma correction of the electrical signal is required to reproduce film properly on television. The type of correction necessary for the proper reproduction of film meeting the new proposed specifications for density range and transfer characteristics of television film is described.

Making Films for Television in Canada

LEON SHELLY, *Leon Shelly & Co., Toronto, Ont.*

Some of the problems involved in making films for television in Canada are discussed. The cooperation of sponsors, advertising agencies, producers, laboratories, optical houses and television stations is needed for solution of these problems.

WEDNESDAY MORNING—MAY 10

9:00 SOUND RECORDING AND REPRODUCTION — 1

Modifications of Tape Reproducing Equipment for Use With the Pilot-Tone Synchronization System

R. R. EPSTEIN and L. O'DONNELL, *National Film Board of Canada, Montreal, Que.*

Motion-picture production requirements for lightweight synchronous location equipment demand battery operated cameras and magnetic recorders. The speed variations of the location equipment are recorded on a low-frequency control track at the center of the $\frac{1}{4}$-in. tape perpendicular to the program modulations. The recordings are reproduced and speed corrected with a playback synchronizer originally designed for a high-frequency carrier system of synchronous recording. The modifications of the synchronizer for this additional use are described and performance data given.

Magnetic-Tape Multiple-Cartridge Reproducers for Re-Recording Applications

G. R. CRANE and G. A. BROOKES, *Westrex Corp., Hollywood*

Two new types of reproducers are discussed. Both have continuous loops of $\frac{1}{4}$-in.-wide magnetic tape stored in a series of individually removable cartridges. Each cartridge can contain a separate effects track and can be selected remotely from the re-recording console. One version contains up to 100 cartridges and employs a common reproducing head and preamplifier. The head traverses the cartridges to the selected position at which time the head and drive are engaged with the cartridge. A second version contains up to 15 cartridges and uses a separate reproducing head and preamplifier for each cartridge.

A Tape Recorder for the Production of Special Sound Material

HUGH LE CAINE, *National Research Council, Ottawa, Ont.*

For more than thirty years the handling of sound records has been one of the techniques required in making motion pictures, but only recently have composers considered the realization of a musical composition by processing and combining recorded material. The result is called "electronic music." Electronic music techniques have been used to produce all the background music in a motion picture, to augment scores for conventional instruments, to produce the unusual sound effects used in science fiction films, and for imaginative extensions of natural sound, as in the recent film *Rosemarie*. For these purposes sound records can best be handled by apparatus superficially resembling the familiar sound mixers, but designed to allow the maximum flexibility in modifying the recorded material. Such apparatus, especially designed for use in an electronic music studio, is described.

Integrated Audio — The "Package" Concept in System Design

J. R. SIMPSON, *Technical Marketing Services, Toronto, Ont.*

Integrated audio systems have been designed and constructed for the control and distribution of program and intercom sound in television and film studio applications. The electrical, physical and human engineering requirements of high-quality master control consoles are discussed, and the evolution of several systems, capable of handling up to twenty simultaneous inputs, is described. A new TV intercom system utilizing solid-state switching techniques and computer mechanics and an audio switcher for integration with TV video switching systems are also discussed. Recently engineered film production and TV studio installations serve as illustrations.

A Bilingual Drive-In Installation

F. DE RENZIS, *Westrex Company Italy, Rome, Italy*

Equipment used for the simultaneous bilingual presentation of sound films in an 800-car drive-in theater near Rome is described.

Multilingual Sound Installation — Palace of Science, Brussels World Fair 1958

GEORGE F. VAN WEYENBERGH, *Westrex Co., France-Belgium, Brussels, Belgium*

The sound picture installation used to present the story of the atom at the Brussels World Fair is described. The presentation includes picture, music and sound effects and a commentary in five languages.

Improving 16mm Optical Sound

RICHARD H. RANGER, *Rangertone Inc., Newark, N.J.*

Soundtrack quality for 16mm film has been on a plateau for about three

NOW YOUR VIEWERS CAN SEE & HEAR THE NEWS VIA 8mm

Now television stations can produce true sync-sound news films locally, at substantial savings over existing methods. With Fairchild's new 8 mm sound movie equipment your productions cost far less than comparable 16 mm or 35 mm sound films.

You need just three pieces: a portable, hand-held 8 mm sound camera; a companion 8 mm sound projector; a rapid film processor. Total cost: about $2,125.

Camera is easy to operate: The camera, weighing less than 5 pounds, has its own power supply and recording system built in. A reporter can carry the whole system in one hand and move quickly in tight places—recording sound as he films action.

The camera records on a 30-mil magnetic stripe, on the film between the sprocket holes and the edge. You set the volume according to the situation. The sound system records 100 to 4800 cps.

With the new camera, you can shoot for about 2¾ minutes on each half of the 50-foot film. The spool is then reversed—for a total shooting time of about 5 minutes, ample time for most interview situations.

Uses conventional processor: You process the 50-foot film spools directly through Fairchild's Mini-Rapid 16 Processor, for negative developing at about 6 feet per minute. This processor, which is currently being used in TV stations throughout the country, requires no changes to handle film from the 8 mm sound camera.

Projector runs the negative: After the film runs through the Fairchild processor as a negative, you slit it to the 8 mm size, splice and run it through a Fairchild 8 mm sound projector. By reversing the electrical polarity of the tube output, the screen gets a positive image.

FAIRCHILD
CAMERA AND INSTRUMENT CORP.

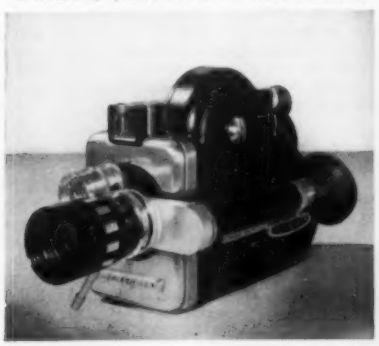
Special TV projector: The projector is a specially developed version of the Cinephonic 8 machine, built entirely to television projection requirements. Its drive motor is a synchronous type, 115V, which runs at 1800 r.p.m.

A five-bladed 50° shutter replaces the standard three-bladed 55° shutter. This makes the projector compatible with the scanning rate of the vidicon, synchronized with the standard 60 cycle reference.

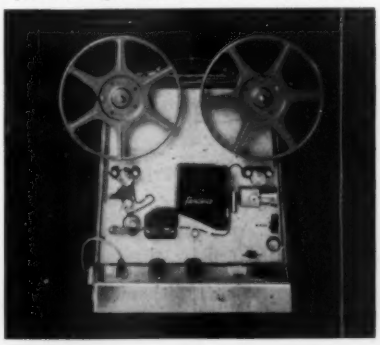
Normal projection lighting of picture is too bright for projection into the tube. So, a variable intensity control is added for changing projector light output. This lets you balance the output of your films.

Free literature: For complete information on the Cinephonic 8 sound motion picture system for TV stations, write to Mr. Herbert M. Oshan, Marketing Manager, Fairchild Camera and Instrument Corporation, Dept. SMP-4, 580 Midland Avenue, Yonkers, New York.

This lightweight camera lets you go almost anywhere to record lip-synchronized 8 mm sound newsfilms.



With the specially adapted Fairchild 8 mm projector, you run the negative as the "finished" sound news film.



As soon as it is shot, your 8 mm film can be processed in the standard Fairchild Mini-Rapid Film Processor.

years since Eastman Kodak introduced the new color printing facility with the negative-positive technique which brought color sound up to the general level of black-and-white. Now both are due for a definite rise. Steps which may accomplish this include: (1) the use of reiteration techniques to increase sound intelligibility; (2) in tape-to-film transfer, the use of an advance pickup head to set compression and A.G.N. just before the same sound variations reach the regular tape playback head; and (3) a wider frequency band cross-modulation technique.

Forward and Reverse Operation of Projection Equipment in Review Rooms

R. A. BULL, *Westrex Co., Ltd. London, England*

Certain economic advantages result from the use of a reversing projection equipment in review rooms, remotely controlled from the auditorium. The essential features of such equipment are described.

WEDNESDAY AFTERNOON

2:00 SOUND RECORDING AND REPRODUCTION — 2

Artificial Reverberation Facilities for Auditoriums and Audio Systems

G. R. CRANE and G. A. BROOKES, *Westrex Corp., Hollywood*

Two new equipments for producing artificial reverberation are discussed. One is intended for audio studio application to introduce special effects. The other is used to increase the effective reverberation time of churches or other auditoriums where the natural reverberation time is below the desired value. The artificial reverberation is produced in a magnetically-recorded multiple-output memory system. In the auditorium application, the reverberation information is fed to a series of side-wall speakers which simulate a series of reflecting surfaces, each set receiving its own distinctive reverberant information. In both auditorium and studio applications, the reverberation time and reverberation frequency response can be controlled over a wide range.

A Wide-Range Wow and Flutter Indicator

L. G. COX, *Radio and Electrical Engineering Div., National Research Council, Ottawa, Ont.*

The design and operation of an instrument for oscilloscopic observation of frequency fluctuations in the output of sound reproducing equipment are described. The instrument indicates the instantaneous rather than average or rms frequency deviation, for frequencies between 500 cps and 20 kc/s. A phase-locked loop permits automatic following of slow-frequency variations over a $\pm 20\%$ range.

Television Intercom Systems — Two New Approaches

GORDON B. THOMPSON, *Northern Electric Co., Ltd., Belleville, Ont.*

Two approaches to solving the TV intercom problem are examined, one which permits the extensive use of telephone-type headsets to provide efficient but economical communication among a great number of people, and another which employs loudspeaker-type communication to provide greatly expanded facilities with due regard to future changes or extension.

A Television Audio Console

JAMES A. LEITCH, *Meridian Films Ltd., Toronto, Ont.*

A 16 input, fully transistorized audio console has been manufactured to meet special requirements. Reasons for adopting practices not normally used in commercially available consoles are outlined. Reference is made to dynamic range in the microphone preamplifier.

Demonstration of the Infrared Transparency of Magnetic Tracks

GEORGE LEWIN, *Army Pictorial Center, Long Island, N. Y.*

Demonstration of Bilingual and Stereophonic recordings on 16mm film with completely superimposed magnetic and optical sound tracks, utilizing the principle of "Infrared Transparency of Magnetic Tracks." Some recent work with the new Eastman Stripe (Kodak Sonotrack) will be demonstrated and compared with the discontinued 3M laminated stripe.

WEDNESDAY AFTERNOON

2:00 EQUIPMENT PAPERS AND DEMONSTRATIONS

WEDNESDAY EVENING

6:45 COCKTAIL PARTY, BANQUET

THURSDAY MORNING—MAY 11

9:30 LABORATORY PRACTICES — 1

The Organization and Operation of a National Network of Kodachrome Processing Laboratories

ELDON E. BAUER, *Dynacolor Corp., Rochester, N.Y.*

A national network of processing laboratories for Kodachrome film has been established. All processing machines and auxiliary equipment have been designed and manufactured by Dynacolor Corp. Each laboratory is operated as an individual profit center, the manager being responsible for his quality and his costs. Independent evaluations of each station's quality and cost performance are made regularly by staff groups in Rochester and a monthly summary of operating efficiencies is published.

How Color Negative Film Surface Characteristics Affect Picture Quality

DAAN ZWICK, *Research Laboratories, Eastman Kodak Co., Rochester, N.Y.*

The surface of processed color negative varies according to the material, the image, and the process. Reticulation, image relief and other surface artifacts in the negative, ordinarily not considered a part of the picture image, can affect the quality of prints. Newton's rings, sharpness, graininess, and even tone and color reproduction can be a function of negative surface. The effects also depend on printing conditions such as degree of film contact or specularity of illumination.

Reversal Color Printing Through Masters

I. B. M. LOMAS, *Crawley Films Ltd., Ottawa, Ont.*

Many 16mm productions require prints made in two or more versions. Printing from the original necessitates constant change from one version to another: hence reversal color masters are proposed for each version. Reference is made to the problems encountered in obtaining masters capable of yielding satisfactory print quality. Particulars are given of the flashing and printing techniques used.

Variation of Speed Rating and Processing for a 16mm Color Film

R. G. F. CHASE and R. J. RUTHERFORD, *Color Film Services Ltd., London, England*

Filming in color under poor lighting conditions may result in inferior picture quality. A process has been developed for rating the film speed for Ektachrome Commercial Type 7255 according to location conditions, compensation being made during processing. The results of this treatment are described and demonstrated.

Arbitrary Scale at Technicolor

WADSWORTH E. POHL, *Technicolor Corp., Hollywood*

The arbitrary scale defines normally exposed negative as one which prints at arbitrary point 12. Good prints can be made from negative all the way from $\frac{1}{2}$ under, to $1\frac{1}{2}$ stops overexposure when normal exposure and arbitrary point 12 are defined in this way, and the arbitrary scale system is a simple reporting method from which a cameraman judges his results.

International Facilities for Release Printing by Technicolor

L. B. HAPPE, *Technicolor Ltd., London, England*

Technicolor laboratories in Hollywood, London and Rome provide unique international facilities for release print manufacture by the interchange of matrices prepared direct from original picture negative. Copies in different formats can be obtained with the same quality from one original and can include dissolve or fade effects by A&B printing without using duplicate negatives. Close technical cooperation ensures worldwide release prints of identical quality despite the use of different raw materials in the various countries.

For every step . . .

a Du Pont Motion Picture Film

The sound, the image, the emotion—each is accurately caught on a Du Pont film. High contrast or low, negative or reversal, there's a Du Pont emulsion that is compounded and balanced to give you consistently predictable results.

If you record data, strike release prints, duplicate original, reproduce sound or use movie film in any other way, you'll find that Du Pont has tailored an emulsion especially for you. These films, such as "Superior"® 2 and 4 negative taking stocks, type 908 fine grain duplicating negative, TV recording film type 834 or type 140 "Cronar"® aerial films, and technical data on them, are readily available from any of the Du Pont sales offices shown.

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Selective Printing of Motion Pictures at Technicolor

ITALO TINARI and WILLIAM B. TUCKER, *Technicolor Italiana S.p.A., Rome, Italy*

A&B printing was introduced by Technicolor in 1954. The system then used required making up the negative in two or more separate rolls with leader between scenes. New equipment has made possible A&B printing automatically from negative mounted in a single roll which gives the same excellent quality, with important savings in time and expense to the customer.

THURSDAY AFTERNOON

2:00 LABORATORY PRACTICES — 2

Fiber Optics in the Motion-Picture Laboratory

ARTHUR J. MILLER and ROBERT HARTSHORNE, *Du Art Film Laboratory Inc.,— Tri-Art Color Corp., New York*

There are several uses of "light pipes," made of fiber optics, in the motion-picture laboratory. Their use is particularly important in illuminating systems of motion-picture printers.

An Inexpensive Precision Microdensitometer

FRANK HERRNFELD, *Frank Herrnfeld Engineering Corp., Culver City, Calif.*

A medium-priced microdensitometer has been designed and built for photographic research. It has a resolving power of about 850 lines/mm when the scanning aperture is 1 μ wide and 40 μ long. The response is linear down to 0.1% transmission for the same aperture. By narrowing the aperture, the resolving power can be increased to 2000 lines/mm. Visual readings can be taken on a self-contained meter or a recording can be made on chart paper with rectangular coordinates.

A Constant-Time, Variable-Intensity Microsecond Exposure Sensitometer

FRANK HERRNFELD, *Frank Herrnfeld Engineering Corp., Culver City, Calif.*

A sensitometer has been designed to make sensitometric strips for film investigation in the microsecond region, utilizing the type 230 flashtube with a constant IT output for the three exposure times of 1.5, 15 and 150 μsec. It features a straight platen with an aperture of 10 by 210mm. Evenness of field is better than 0.01 log E. Reproducibility of exposure during the useful life of the flashtube is better than 2%.

Rapid Processing of Motion-Picture Film by the Application of Viscous Coatings — Part I: Viscous Processing of Motion-Picture Film

GEORGE E. CUMMINS, JOHN R. TURNER and ROBERT J. WILSON, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*

A method has been developed for the rapid processing of black-and-white motion-picture film by the application of thin coatings of viscous chemical solutions. The chemical treatments are carried out in an atmosphere saturated with water vapor at an elevated temperature. The physical and photographic quality of positive film processed by this method is equal to that obtained from conventional processing. The chemical solutions used for these treatments maintain their properties over extended periods of storage under normal conditions. The usual problems of chemical control are eliminated, thus permitting automatic operation of the processing system.

Rapid Processing of Motion-Picture Film by the Application of Viscous Coatings — Part II: A Machine for the Rapid Processing of 16mm Films

PAUL A. HERMLE, *Apparatus & Optical Div.*, and HAROLD D. LOWRY, *Color Technology Div., Eastman Kodak Co., Rochester 4, N.Y.*

A rapid simplified processing machine for 16mm black-and-white positive films employs thin coatings of viscous solutions for the developing and fixing treatments at a temperature of 125 F. The film is processing to a precontrolled density and contrast at an operating speed of 36 ft/min, and a dry-to-dry time of 1 min. Packaged chemical solutions are used, metered to the film from an 8-hr storage capacity within the machine. The only service connections required are electricity, hot water and drainage.

A High-Speed Continuous 16mm to 8mm Reduction Printer

KENNETH B. CURTIS and WILLIAM D. HEDDEN, *Calvin Productions Inc., Kansas City, Mo.*

Optimum quality 8mm release prints usually are obtained by direct reduction from 16mm negatives. Most 8mm reduction printers are of the step type, operating at relatively slow speeds. A continuous 8mm optical reduction printer running at 250 ft/min is described. Quality advantages of reduction printing are combined with production advantages of continuous printing. Sprockets on a common driveshaft and a U-shaped optical system are used.

A Damping Device to Improve Image Sharpness and Steadiness of Prints Made on a Continuous 16mm Motion-Picture Printer

G. M. SEELEY, *Fim Testing Div., Eastman Kodak Co., Rochester, N.Y.*

A simple modification to the gate shoe of a 16mm Bell & Howell Model J printer is described. A nylon velvet pad is positioned over the printing aperture in such a way that closer film-to-film contact is produced. This also reduces spurious film movements at the aperture.

Printer Steadiness: Its Rating and Its Improvement

A. C. ROBERTSON, *Kodak Park Works, Eastman Kodak Co., Rochester, N.Y.*

A method is described for determining the unsteadiness of printers independently of the steadiness of any projector which may be used to examine the prints. The operation of continuous and step printers is discussed. Quantitative measurements are given for the steadiness of prints made before and after adjusting the alignment of the machines. Similar data are given for prints made before and after altering the gates of continuous printers. Attention is called to the need for constructing the gates of step printers so that the pins are properly placed with respect to the picture aperture. This precaution is desirable in order to get the "cancellation" that minimizes errors in perforation even though these errors are small today. It has been found that systematic use of the printer steadiness test gives information in a useful form and leads to better maintenance of equipment than has formerly been the case.

THURSDAY EVENING

7:30 TELEVISION RECORDING

Video-Tape Editing System

W. J. HANEMAN and H. OSTROW, *Astro-Electronics Div., Radio Corp. of America, Princeton, N.J.*

The television industry has a need for a system which will facilitate video-tape editing operations. The function of editing is to determine, on the basis of program content, the precise frame at which tape segments are to be added or deleted. It is then necessary to locate this frame and make the splice. A system of editing has been devised in which a number generator identifies each video frame with a frame number recorded on the cue track of the video tape. This number is used during tape playback in conjunction with three storage monitors and number displays to determine the exact frame at which the tape is to be edited. The monitors may display frames at fixed frame intervals or they may display only those frames selected by means of the frame numbers. An editing transport is used to search the tape for the selected frame number. The tape is stopped within $\frac{1}{8}$-in. of the selected frame and the splice may then be made. This system permits a splice to be made with single-frame accuracy.

A Standard for Positioning the Vacuum Guide in Transverse Track Video-Tape Recorders

A. H. LIND, *Electronic Recording Products Engineering, Radio Corp. of America, Camden, N. J.*

The SMPTE Video-Tape Recording Committee has developed a Recommended Practice for transverse track video-tape recording which results in a constant recorded video-track length per TV line period. Adherence to this Recommended Practice will improve the interchangeability and interspliceability of recorded tapes. The Recommended Practice establishes the proper position of the vacuum guide with respect to the axis of rotation of the video heads as a function of the vacuum guide radius. The background for this Recommended Practice is outlined and the relationships that are specified in it are explained.

Time Base Errors and Their Correction in Magnetic Television Recorders

AUBREY HARRIS, *Ampex International Operations, Inc., Redwood City, Calif.*

During the recording process, in a magnetic television recording system the time relationships of the various parts of the signal waveform are transferred to the recording medium in elements of space. This operation, and the inverse, which occurs on reproduction, may cause undesirable time displacement errors in the reproduced picture. The factors influencing these errors are outlined and discussed. Methods of reducing the errors and of increasing the time stability of the output signals by electro-mechanical and electronic means are described.

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Equipment and Facilities of a Complete Motion-Picture Recording Service

JOSEPH E. BLUTH, *Glen Glenn Sound Co., Hollywood*

Described is a major new facility, the Glenn-Armistead mobile TV recording units. Other facilities are also described and illustrated with slides. The firm's approach to editing is outlined with special emphasis on the integration of motion-picture techniques into video-tape production.

CBS Television Standards Conversion Techniques

K. BLAIR BENSON, *CBS-TV, New York*

The advent of video tape has provided a means for the rapid intercontinental exchange of television programs wherein the transmission delay need not exceed the travel time of modern jet aircraft. However, the difference in picture scanning parameters employed by various nations often prohibits broadcasting the video signal in its original form and necessitates a conversion to the appropriate transmission standards. Problems related to the design of converters for this purpose are discussed and the equipments used by CBS are described.

Shutter-Bar in Picture-Tube Recording

C. H. EVANS, *Research Laboratories, Eastman Kodak Co., Rochester, N.Y.*

Conversion from the rate of 60 television fields/sec to 24 film frames/sec in TV film recording is generally accomplished by omitting from the record every fifth consecutive half-field. Consequently, there is a picture splice across the center of every other film frame. In a camera having a properly adjusted mechanical shutter, all points of the picture receive the correct total exposure. However, the exposure intensity and time relationships differ for points inside and outside the splice, and this can lead to a density difference across the splice. This form of shutter-bar has been eliminated in a new experimental television recording film.

Marconi Television Film Recorder

JAMES A. LEITCH, *Meridian Films Ltd., Toronto, Ont.*

A recorder has been constructed capable of producing a high-quality 16mm film from the television system. A description is given of means used to transfer the 30-cycle TV frame to the 24-frame/sec film standard, the electronic circuitry used to drive the cathode-ray tube is given. A sample of the film produced by this recorder is shown.

FRIDAY MORNING—MAY 12

9:00 TELEVISION STUDIO PRACTICES AND STATION OPERATION

Design of Production Lighting Controls for British Television

F. BENTHAM, *Strand Electric & Engineering Co., Ltd., London, England*

In Great Britain, lighting control has assumed great importance both as an instrument of dramatic expression and for monitoring picture quality. The lighting supervisor (director) often works the control directly without the intervention of an electrician. The quality of automatic memory derived from the inertia of electromechanical dimmer systems has simplified the design of these controls and in consequence has caused many users in Britain to be reluctant to adopt all-electric forms of dimmer such as the thyratron and S.C.R. which suggest multipreset networks.

Television Studio Lighting

K. R. ACKERMAN, *BBC, London, England*

Imaginative equipment design can spectacularly reduce the time and labor required for the rigging and adjustment of lighting and for the setting of scenery. Considerations in lighting are dimming and lighting control equipment; the suspension, hoisting and adjustment of luminaires; and the design of luminaires. Scenery handling requires the use of electric hoists, electric tractors and trailers; cyclorama tracks and cloth-handling equipment; and rotating stages and portable audience seating. The equipment and devices noted above are used by the BBC Television Centre, London.

ADB Storage Memorized Light Control

JEAN DE BACKER, *ADB Etablissements Adrien De Backer S.A., Zaventum, Belgium*

Operation of lighting stages or TV studios becomes too complicated for the operator even with present preselection systems. Equipment involving a control console; remote controlled magnetic amplifiers, or silicon controlled rectifiers; intermediate triple electromagnetic memory; punched-card machine; and repeater normal typewriter is used to reproduce automatically all lighting "states" determined during rehearsals. The operator controls the transfer from one state to the next one by pushbutton action.

Black-and-White Television Picture Monitoring and Video Levels

HAROLD WRIGHT, *Canadian Broadcasting Corp., Toronto, Ont.*

The current state of TV broadcast monitoring is reviewed. The need for accurate control of video peak-to-peak voltages is justified by considering them relative to transmitter and video-tape recorder modulation, network transmission and the retention of picture aesthetics from source to audience. Generation of video waveforms by live and telecine cameras is reviewed and accurate interpretation of the oscilloscope display is emphasized. Black-and-white references are considered and the relation of these to face tones and glints is discussed with and without peak white clippers in operation.

New Frontiers in Television Camera Tubes

R. G. NEUHAUSER, *Electron Tube Div., Radio Corp. of America, Lancaster, Pa.*

A multitude of new TV camera tubes have been brought out in the past year, including both vidicons and image orthicons. The performance of these tubes is discussed in terms of their suitability for different applications and the conditions under which they must operate. Performance of these camera tubes is discussed. In the image-orthicon line, the trend is towards specialization. New image orthicons have been designed to produce better black-and-white pictures and for new camera designs, or to produce color pictures in black-and-white studio-lighting levels; others were designed for very-low-light-level remote pickups where lighting conditions are extremely adverse. The performance of the new vidicons reflects recent improvements in sensitivity; lower gamma characteristics produce better tonal renditions and low-light sensitivity. In addition, several new types have been introduced for special pickup work for both broadcast and industrial TV uses.

Picture Characteristics of Image-Orthicon and Vidicon Camera Tubes

R. G. NEUHAUSER, *Electron Tube Div., Radio Corp. of America, Lancaster, Pa.*

The vidicon has not generally replaced the image orthicon for live broadcast work in spite of the fact that its resolution is as good or better, and its effective sensitivity now approaches that of the image orthicon. This is primarily due to the basic difference in the picture characteristics of the vidicon and the image orthicon.

The secondary electron redistribution characteristics of the image orthicon, which are at times criticized as producing an inaccurate picture, can contribute to making the picture appear to be a somewhat better picture than the TV system is normally capable of producing, when the human eye and brain are considered as part of the system. These characteristics also compensate for some of the basic aberrations in a TV electro-optical system. Basic differences in the signal characteristics generated by the image orthicon and the vidicon are described in detail. Methodes for obtaining the best performance from each are suggested.

Investigation of Image-Orthicon Camera Flicker

KIYOSHI YAMAGUCHI, NOBORU YOSHIWARA, HARUO UMEHARA and KEIMA UEDA, *Nippon Hoso Kyokai (Japan Broadcasting Corp.), Tokyo, Japan*

Flicker is the most significant factor in the deterioration of television picture quality. Certain types of flickers from an image-orthicon camera originate in the low-frequency component, arising from the pairing of the interlace scanning and the asymmetrical distribution of the beam density. Several experiments and theoretical treatments about this flicker are given.

FRIDAY AFTERNOON

2:00 TELEVISION STATION OPERATION AND EQUIPMENT

Technical Equipment and Facilities of the BBC Television Centre, London

SIR HAROLD BISHOP, *BBC, Broadcasting House, London W.1., England*

The BBC's new Television Centre, which is about four miles west of the center of London, and cost about £10 million, has been designed to include seven studios, in addition to two presentation studios. The first studio was brought into operation on June 29, 1960, and was followed later by a second studio; two more studios will be brought into operation in the summer of 1961. These four studios, with their ancillary areas and technical facilities, will complete Stage I of the project. Three more studios are to be added later, and the Centre will then be capable of producing 1500 hours of electronic program material each year, about half of the total output of the BBC Television Service. Equipment in the studios and their associated control rooms, and in the presentation studio, the central apparatus room, and the film scanner suite are described. A number of recent developments, incorporated in the planning of the technical facilities, are outlined.

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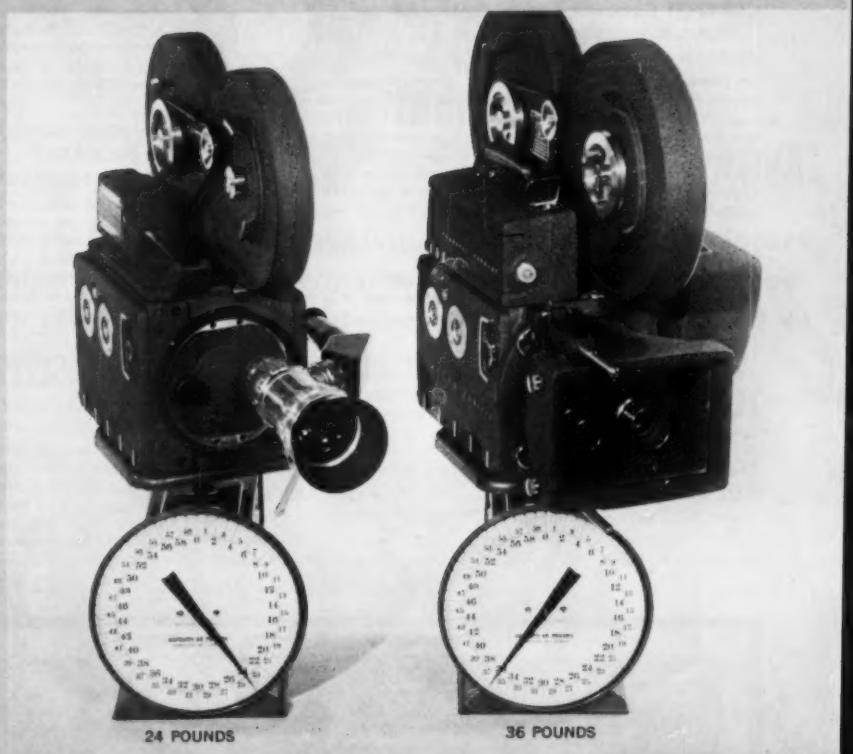

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The Technical Organization Behind Eurovision

GEORGES HANSEN, *European Broadcasting Union, Brussels, Belgium*

The technical organization and facilities required for program exchanges among the twenty-four television services in sixteen countries that now constitute the European Television Community (Eurovision) are described. Practical problems are posed by fundamental differences in the cultural values and economic situations of the various countries, and by equipment and language differences. The present scale of operations is outlined and a number of possible future developments are predicted.

CBS-KNXT Computer Control System for Program Switching

ADRIAN B. ETTLINGER, *CBS Television Network, New York*

On December 31, 1960, the world's first computer-controlled broadcasting plant went "on air." In the new CBS-KNXT studio plant, located in Hollywood, a special-purpose digital computer is used to control the sequential switching among the various program components. Automation of the switching functions during the recurrent station-break "panic periods" allows the operator to devote his primary attention to maintenance of quality. In addition to a detailed description of the KNXT installation, operational experience gained in this pioneer effort is reviewed.

Reception and Rebroadcast of Stratovision Aircast Employing Parametric Amplifiers

D. M. WEISE, *Chicago Educational Television Assn., Chicago*

The Midwest Airborne Broadcasts on UHF channels 72 and 76 are received and are broadcast by WTTW, Chicago, on VHF Channel 11. The airborne transmitting location is about 150 or 160 miles from Chicago and thus offers unique opportunities for evaluating reception conditions employing parametric amplifiers at UHF television frequencies. The techniques employed, and reception data obtained are compared with standard broadcast UHF receiving equipment.

The Edging of Letters Superimposed in Television Pictures

KIHACHIRO MATSUYAMA, TSUKASA TAKATSUJI, and KATSUYA MIYAGISHIMA, *Nippon Hoso Kyokai, (Japan Broadcasting Corp.), Tokyo, Japan*

In Japan, when broadcasting foreign TV motion pictures, white Japanese letters, explaining or translating the dialogue are superimposed on the film. It is often difficult, however, to read the letters because of the variation of the brightness of the film scene. To make the white letters more clear and readable, an electric device is used to edge each letter in black and also to maintain an even brightness where the letters are superimposed without affecting brightness variation of the scene.

A Television Technical Monitor

GORDON C. FIELD, *Northern Electric Co., Ltd., Belleville, Ont.*

A technical monitor has been designed to provide a high-quality means of visually monitoring television video signals. The problem of obtaining d-c restoration, unaffected by the presence or absence of synchronizing information, is considered. A back porch clamp circuit with a new drive arrangement is described with special reference to its design. Also discussed are the design of the wideband video amplifier, the low distortion deflection system, and the regulated power supplies of the monitor.

Television Studio Camera Mounting Developments in Europe Since 1948

DENNIS C. WARD, *W. Vinten Ltd., London, England*

Motion-picture camera mountings were employed in the early days of television, and modified where possible to suit the new requirements. The new medium required special equipment to provide greater mobility in cramped studios, where the "long take technique" was employed on every live production. Today's television camera transporter designer works with the firm requirements of fast and silent operation coupled with extreme mobility. The magic words associated with future developments in this field appear to be "remote control."

A Transistorized Synchronizing Signal Generator

J. S. MYLES and J. N. REID, *Research and Development Div., Northern Electric Co., Ottawa, Ont.*

A sync generator which employs only semiconductors as amplifying and switching devices is described. The standard EIA outputs are formed by a unique method of pulse selection from a single pulse train and the start and duration of each portion of these waveforms have a precise time relation to the originating pulse train. Some examples of the circuit design are presented and some of the electrical and mechanical features of the generator are discussed.

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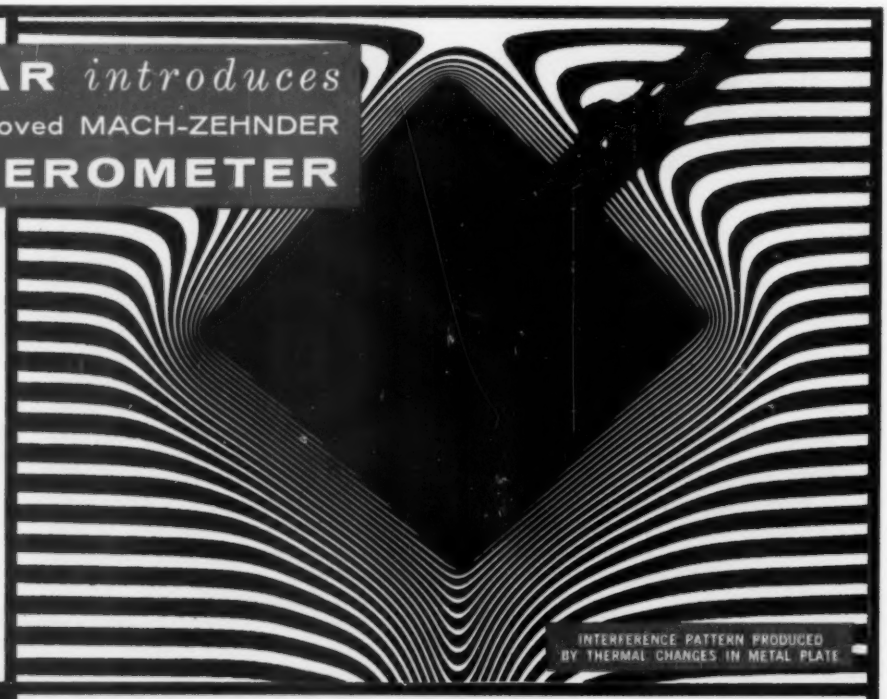

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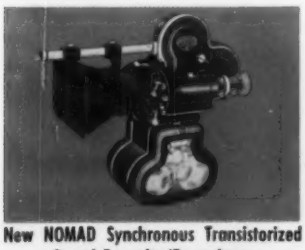

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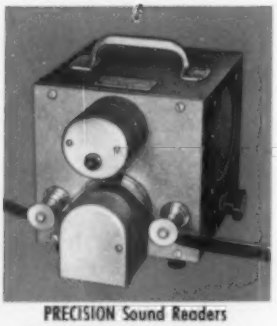

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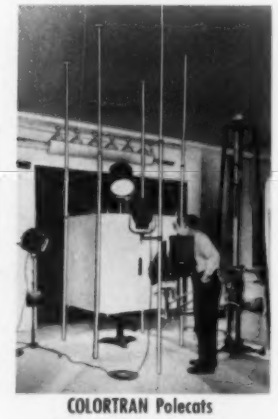

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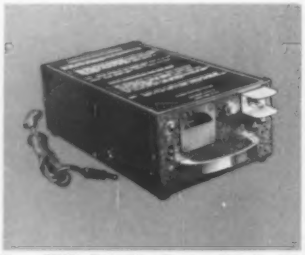

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Exhibiting: Soundcraft and Gotham Audio products; Newman Microphone; Disc Cutting Lathes; Burling Meters.

Personnel: D. I. Snell, E. Schmidt, G. B. Bassett, John Van Bruchem.

Animation Equipment Corp. Booth **30**
38 Hudson St., New Rochelle, N.Y.

Exhibiting: New OXBERRY 35/16mm process camera for animation. OXBERRY 35/16mm shuttle for film movement. New OXBERRY film on aerial image.

Personnel: Ed Willette, Tony Lover.

Beckman & Whitley, Inc. Booth **6**
973 San Carlos Ave., San Carlos, Calif.

Exhibiting: Ultra High-Speed Cameras.

Personnel: Robert D. Shoberg, Frank Provost.

Behrend Cine Corp. Booth **33**
161 East Grand Ave., Chicago 11, Ill.

Exhibiting: Cameras, recorders, lighting equipment.

Personnel: Jack Behrend, Dorothy Behrend.

Bell & Howell Co. Booth **29**
7100 McCormick Rd, Chicago 45, Ill.

Exhibiting: B & H Model JM-2 16mm Printer; B & H Model 614CBVM TV Vidicon Projector; Xenon 16mm Motion Picture Projector.

Personnel: Ken Oakley, Jim Wassell, Joe Quateman, Hans Wohlrab.

Braun of Canada Equipment Ltd. Booths **37, 38**
35 Haas Road, Rexdale, Ont.

Exhibiting: Representing Arnold & Richter, Munich, Germany: Arriflex cameras and film equipment. Also representing Taylor, Taylor & Hobson, London: Cooke lenses.

Personnel: Sam Corlett, A. H. Simmons.

Caldwell A/V Equipment Ltd. Booth **3**
447 Jarvis St., Toronto, Ont.

Exhibiting: Film handling equipment.

Personnel: Pete Elliott, Jake Wiens, Bruce Emonson.

Camera Equipment Co., Inc. Booths **45, 46**
315 West 43rd St., New York 36, N.Y.

Exhibiting: Photo instrumentation cameras and accessories. Stop motion projectors, programmers, camera mounting equipment & reflex camera conversions.

Personnel: Frank C. Zucker, Eugene H. Levy, Allan Green, Louis J. Girola.

Canadian Applied Research Ltd. Booth **47**
750 Lawrence Ave., West, Toronto 19, Ont.

Exhibiting: The Type 246 Tri-Film Processor; The Type 232 Mark 7 Instrumentation Camera; The Mark 4 Timer and Exposure Intervalometer; Accessories for the Mark 7 Camera.

Personnel: D. J. Dalzell, G. J. Evans, W. V. O'Leary, J. W. Ames.

Alex L. Clark Ltd. Booths **21, 22, 23, 24**
3751 Bloor Street West, Islington, Ont.

Exhibiting: Cameras, lighting, editing, laboratory equipment.

Personnel: Mrs. A. L. Clark, Roy Ramsdale, K. Jones, W. G. Farrow, G. Birley, G. Quinney.

E.M.I.-Cossor Electronics **Booth 25**
Woodside, Halifax County, Nova Scotia

Eastman Kodak Company Booths **35, 36**
Rochester, N.Y.

Exhibiting: Eastman Vicomat Processor, Model 10 P.

Personnel: Eric C. Johnson.

Florman & Babb, Inc. Booths **27, 28**
68 West 45th St., New York 36, N.Y.

Exhibiting: Acmade Mark II Editing Table; Triplex Animation Stand; F&B Mark II Tripod; F&B Nickel Cadmium Batteries; F&B Magic Mylar.

Personnel: Arthur Florman, Leonard Hollander, Charles Lipow.

Harwald Co., Inc. Booth **1**
1245 Chicago Ave., Evanston, Ill.

Exhibiting: Editing equipment. Automatic film inspection equipment.

Personnel: Richard Wallace, Sam Caldwell, Robert Grunwald.

Hi-Speed Equipment, Inc. Booth **31**
73 Pond St., Waltham 54, Mass.

Exhibiting: Hi-Speed Model FA-50 Spray Processor, for 16/35mm perforated or unperforated film at speeds up to 50 ft/min.

Personnel: Nicholas Cedrone, Richard Reedy, Robert Sayer.

Hollywood Film Co. Booth **5**
956 Seward St., Hollywood 38, Calif.

Exhibiting: Editing equipment, film splicers, tape splicers, portable 35mm projector.

Personnel: Ben Teitelbaum, Harry Teitelbaum, Sheldon Kaplan, Arnold Scott.

Philip A. Hunt Co. Booth **26**
Palisades Park, N.J.

Exhibiting: High-speed liquid fixers. New style packing of bulk photo chemicals.

Personnel: Eugene P. Kuhn, Charles F. LoBalbo, Charles W. Dole.

Lipsner-Smith Corp. Booth **4**
3475 West Touhy Ave., Chicago 45, Ill.

Exhibiting: CF-2 Film Cleaning Machine; Lawley Film Processing Machine.

Personnel: Jerry S. Lipsner, E. Werner, Eli Smith.

Magna-Tech Electronic Co. Inc. Booth **7**
630 Ninth Ave., New York 36, N.Y.

Exhibiting: MTE 35mm and 16mm magnetic and optical recorders and dubbers, 17½mm magnetic recorders, combination 17½/35mm location recorder, transistorized synchronous inverters, playback synchronizer, control track generators, solid-state noise suppressor, compressors, mixing consoles and associated components.

Personnel: O. Popelka, D. F. Civitillo, G. Wurzer.

McCurdy Radio Industries Ltd. Booth **11**
22 Front Street West, Toronto, Ont.

Exhibiting: New television audio control console plus associated equipment.

Personnel: Geo. E. McCurdy, Norman Farr, Kenneth MacKenzie.

Mitchell Vinten, Inc. Booth **43**
521 Fifth Ave., New York, N.Y.

Exhibiting: TV Camera Pedestal; Type III Pan & Tilt Head; Remote Pan & Tilt Head; Angled Camera Mount; Outside Broadcast Dolly; H. S. Camera.

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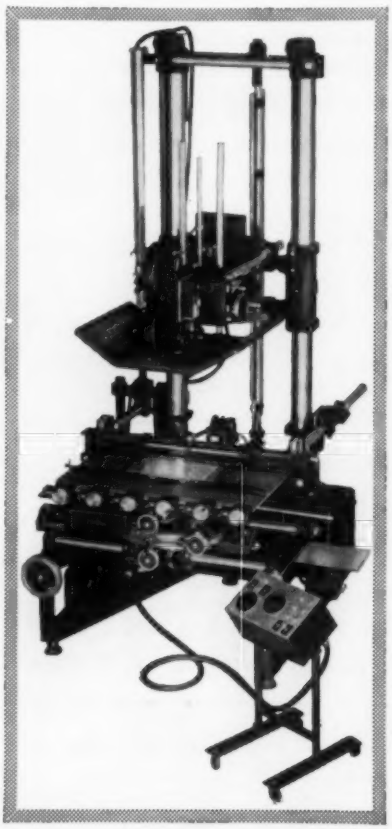

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Motion Picture Enterprises, Inc. Booth **14**
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Exhibiting: Film reels, cans and shipping cases; video tape reels; professional editing and laboratory equipment; Marguet splicers; Motion Picture and TV Service Directory.

Personnel: Herbert R. Pilzer, Victor Thomas.

Northern Electric Co. Ltd. Booths **15, 16**
1600 Dorchester Blvd. West, Montreal, Que.

Exhibiting: Television studio control room equipment.

Personnel: Engineering personnel from sales office at Toronto & mfg. plant at Belleville, Ont.

Precision Laboratories Div., Precision Cine Equipment Corp. Booth **10**
1037 Utica Ave., Brooklyn 3, N.Y.

Exhibiting: Precision Sound Readers, optical & magnetic; Precision Unitized Synchronizers; Power Film Slitters; Film Slitters and Editing Equipment.

Personnel: Irwin R. Sheldon.

Robert Rigby Ltd. Booth **2**
"Premier" Works, 4/6, Northington St., London W.C.1, England

Exhibiting: Film handling equipment, synchronizers bloopers, splicers, track readers, rewinders, time counters.

Personnel: Peter P. Rigby.

L. B. Russell Chemicals (Canada) Ltd. Booth **13**
77 Crockford Blvd., Scarborough (Toronto), Ont.

Exhibiting: Photo chemicals.

Personnel: A. W. Barker, Martin Waters.

See Cue Devices Ltd. Booth **44**
433 Jarvis St., Toronto 5, Ont. (Represented by Mackenzie Equipment Co. Ltd.)

Exhibiting: Autocue synchronous prompting equipment.

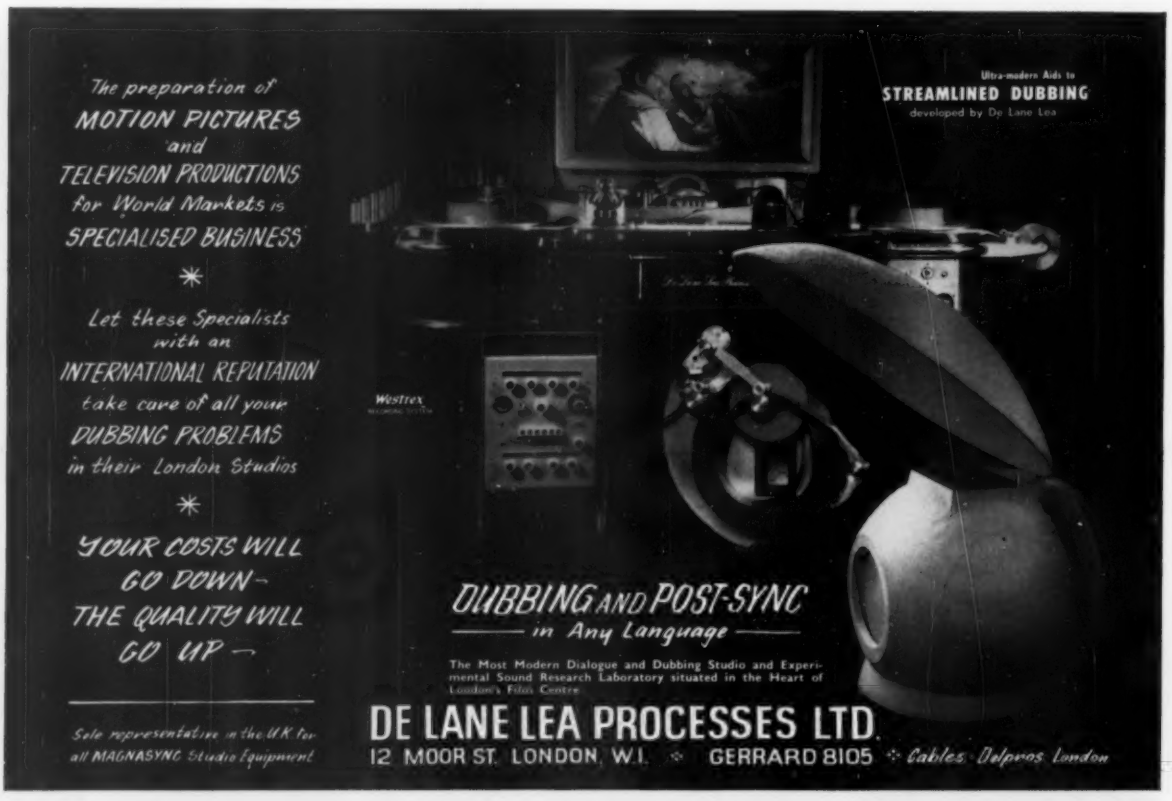
Personnel: Robert B. Mackenzie, G. Norris Mackenzie.

S.O.S. Cinema Supply Corp. Booth **32**
602 West 52nd St., New York 19, N.Y.

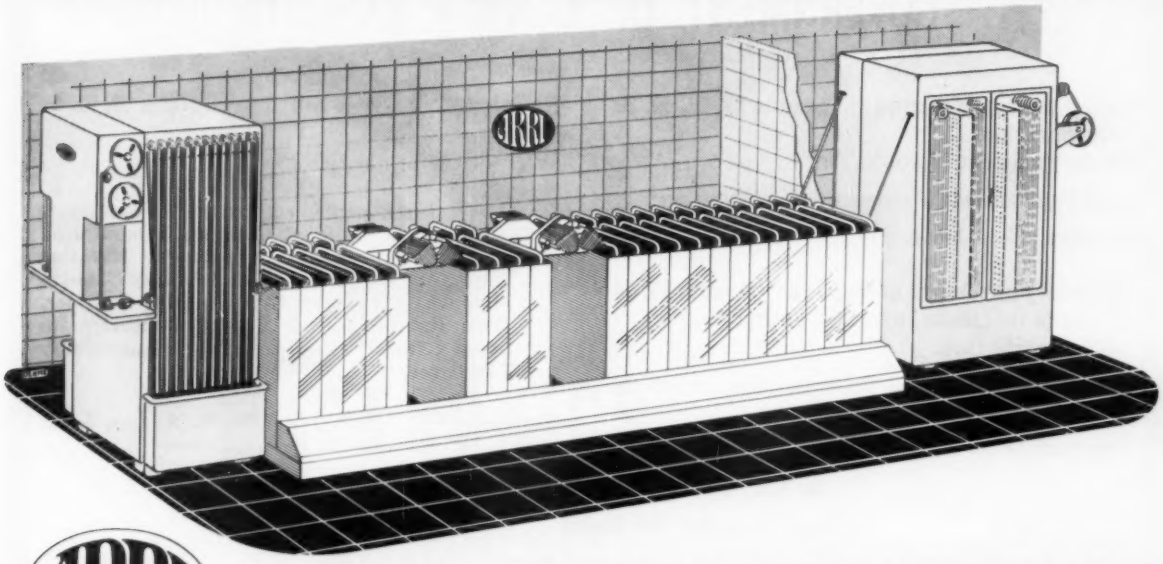
Exhibiting: Magnetic stripping machines, negative cleaning machines, optical reduction printers, automatic processors, 16mm & 35mm viewers, hot press titling machine.

Personnel: D. Capano, O. Cain, J. A. Tanney.

Continued on p. 218



GOING INTO KODACHROME?



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Canadian Broadcasting Corporation Booths **17, 18, 19, 20**
354 Jarvis Street, Toronto, Ont.

Exhibiting: Canada's national broadcasting system.

Personnel: Cecil Johns.

National Film Board of Canada Booths **53, 54**
3255 Cote de Liesse Road, St. Laurent (Montreal), Que.

Exhibiting: Sprocketape Recorder; Special Effects Process; Prototype Densitometer.

Personnel: Denis Gillson.

National Research Council of Canada Booths **50, 51, 52**
Ottawa 2, Ont.

Exhibiting: Instruments, equipment & techniques developed in National Research Laboratories: Rotating Mirror Streak Camera; Rotating Drum Streak Camera; Auroral All-Sky Camera; Meteor Spectography; Creative Tape Recorder; Wide Range Wow & Flutter Indicator; Infrared Camera; Noise Excluding High-Fidelity Earphones.

Personnel: F. R. Parks, G. Ellis, R. A. Lay, L. G. Cox, Dr. H. LeCaine, R. Wlochowicz.

Royal Canadian Air Force Booths **48, 49**
Ottawa, Ont.

Exhibiting: Metric Photo Equipment.

Personnel: Flying Officer J. J. Francis.

Acceptance of the MOVIOLA CRAB DOLLY for motion picture and television cameras is world wide as evidenced by unsolicited testimonials.

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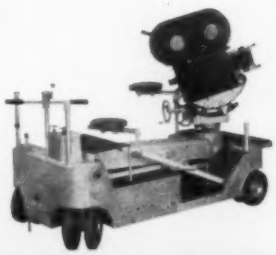

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Strand Electric Ltd. Booth **34**
755 Yonge St., Toronto 5, Ont.

Exhibiting: Television lighting and rigging, also draperies, Cycloramas etc.
Personnel: Leslie Yeo, Philip Rose, F. P. Bentham, Don Sinclair.

Thompson Products Ltd., Electronics Div. Booth **9**
St. Catherines, Ont.

Exhibiting: Closed-circuit television equipment & tape recorders.
Personnel: B. D. Coyne, H. J. Coyne, B. Gelder, Campbell.

Viditon Corporation Ltd., Ferrania Div. Booths **39, 40, 41, 42**
Toronto, Ont.

Exhibiting: Ferrania motion-picture film materials.
Personnel: V. E. Gruodis, I. B. M. Lomas, M. Henninger, L. Monteleoni, J. E. Crook.

Wollensak Optical Co. Booth **12**
850 Hudson Ave., Rochester 21, N.Y.

Exhibiting: Professional Lenses, Pro-35, Pro-70 Industrial Zoom; Fastax Hi-Speed Cameras; Cramer Processor; Mirrortel Radar Boresights.
Personnel: Fred M. Emens, Richard Youso, John Bacon.

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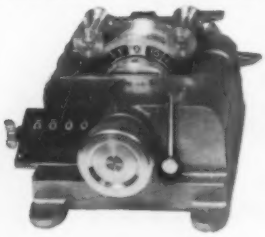
Precision Unitized Film Synchronizer



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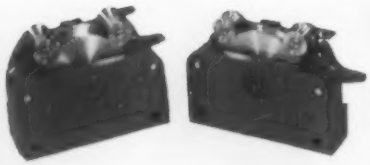

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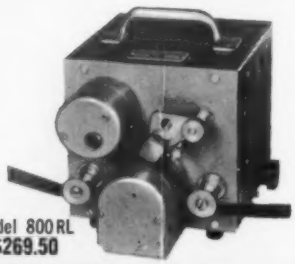
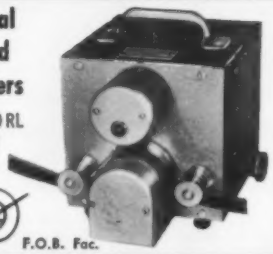
Model 800 **$259.50**



Model 800 RL **$269.50**

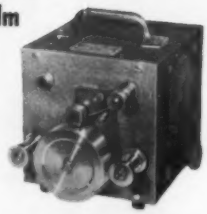
optical sound readers

Model 600 RL **$195.00**



F.O.B. Fac.

magnetic film and tape sound reader



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Education, Industry News

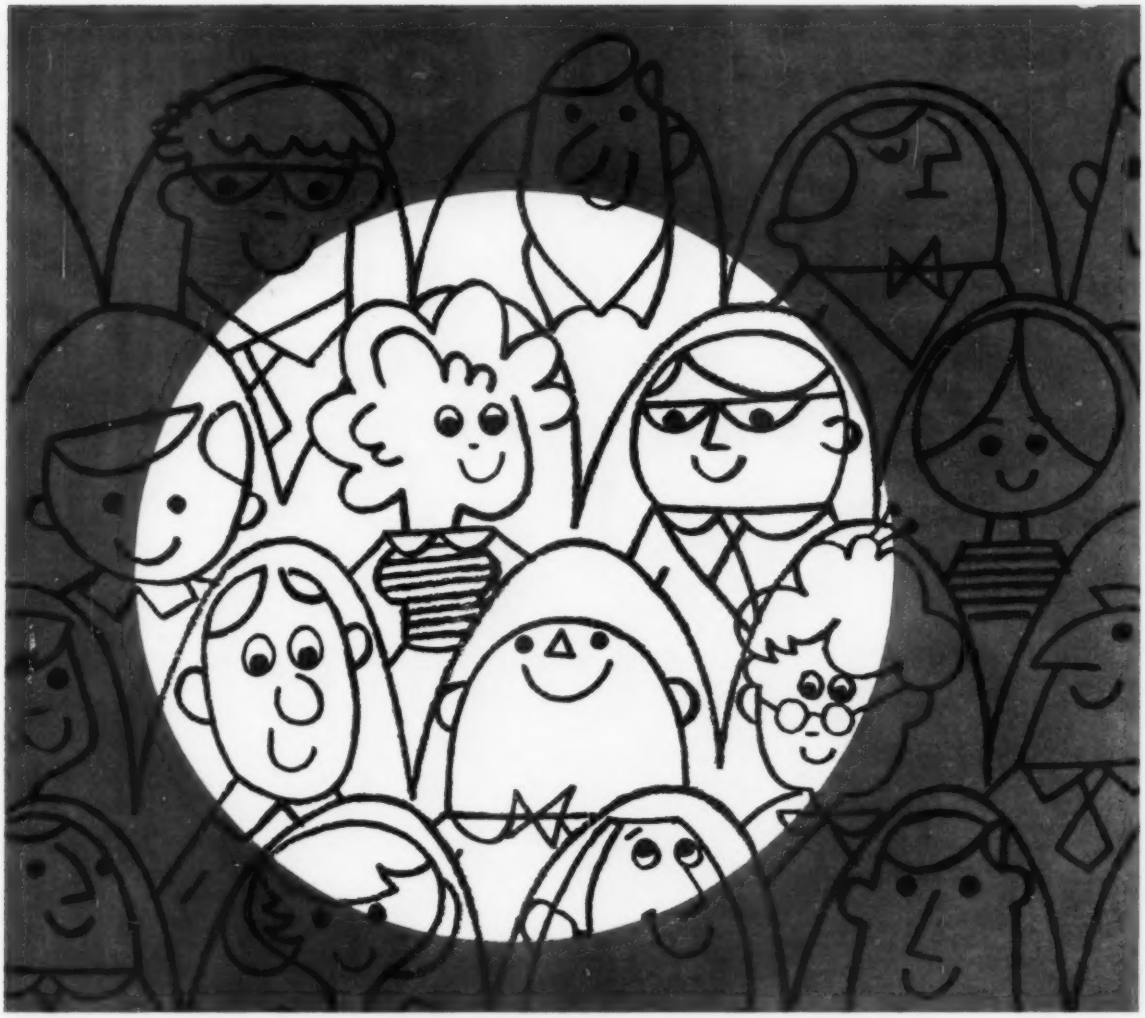
The two-day Symposium on Color in Photography and Television to be held as part of the 30th Annual Meeting of the Inter-Society Color Council, April 10–12 at the Sheraton Hotel, Rochester, N.Y., will present five internationally recognized experts on color, plus the famous motion picture, *Blue Angels*. Discussion at the Symposium on April 11 will be on a talk by R. O. Edgerton, of Eastman Kodak Co., on "How Color Photography Works," and a talk by W. A. Ready, also of Eastman Kodak, entitled "No Charge for the Picture."

Speakers scheduled to appear at the Symposium on April 12 are W. T. Wintringham, of Bell Telephone Laboratories, who will speak on "Principles of Color Television"; John Wentworth, of RCA, who will speak on "Magnetic Tape Recording for Television," and R. Reid Davis, of NBC, who will speak on "Differences in Stage Preparation Between Black-and-White and Color TV Live Shows." Further information is available from Ralph M. Evans, Secretary, Inter-Society Color Council, Color Technology Div., Bldg. 65, Eastman Kodak Co., Rochester 4, N.Y.

The Society of Photographic Scientists and Engineers has scheduled additional papers on aerial and space photography for its annual conference, May 22–26, Binghamton, N.Y., since publication of the announcement in the February 1961 *Journal* (p. 116).

Subjects to be discussed include a revival and refinement of the panoramic camera, a once moderately popular design that has almost disappeared, to be described in a paper by Karl G. Leistner and Dieter P. Paris. Problems involved in the scanning of the Earth from a fast-moving airborne platform will be outlined. In another paper by Mr. Paris, the influence of image motion on the resolution of a photographic system is shown as applied to aerial reconnaissance.

High-acuity aerial photography methods are the subjects of papers by George E. Bennewitz, A. W. Berg, and Marilyn Levy. Their papers describe photographic subsystems for aerial pictures, high-acuity reproductions of aerial photographs, and a high-resolution exposure determinant for aerial films. Other scheduled papers deal



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The FULTON Automatic Continuous Film Processor now makes it possible for every industrial or commercial user of motion pictures, microfilm or roll film, to process their own films . . . to the finest laboratory quality . . . at lower cost than ever before possible . . . as little as 25¢ per 100 feet!

FULTON Processors are completely daylight operated, portable, operate from any 115 volt a.c. outlet, and use ¾" garden hose for water and drain connections. There are **no installation costs!** As little as 16 ounces of working solution are required and replenishment is completely automatic. Water requirement is 2 gallons per minute, or less.

Prices start as low as $1875 for the standard 16mm, 8 fpm, black-and-white reversal model. Higher speeds are available.

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Direct Inquiries to:
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with applications in fields related to high-speed aerial photography and the tracking of rockets, missiles and satellites.

Technical training by televised instruction reached a mature point early in 1959 at the U.S. Air Force Air Training Command, Lowry Air Force Base, Denver, Colo., when the first class to receive technical training entirely by means of closed-circuit TV was graduated. Reported in the September 1959 *RCA Broadcast News*, the entire issue is devoted to a detailed account of the 24-week televised course on Bomb Navigation Systems Mechanics. Tests indicated that the TV-trained students retained about 8% more information than students given the same instruction by highly qualified teachers. Students in the TV-trained classes can participate in discussions via microphone. When a "question button" is punched, the instructor sees a lighted number under his studio monitor, indicating the class from which the question originates. When he is ready to answer, he asks for the question and the question and answer can be heard by all the TV-taught classes.

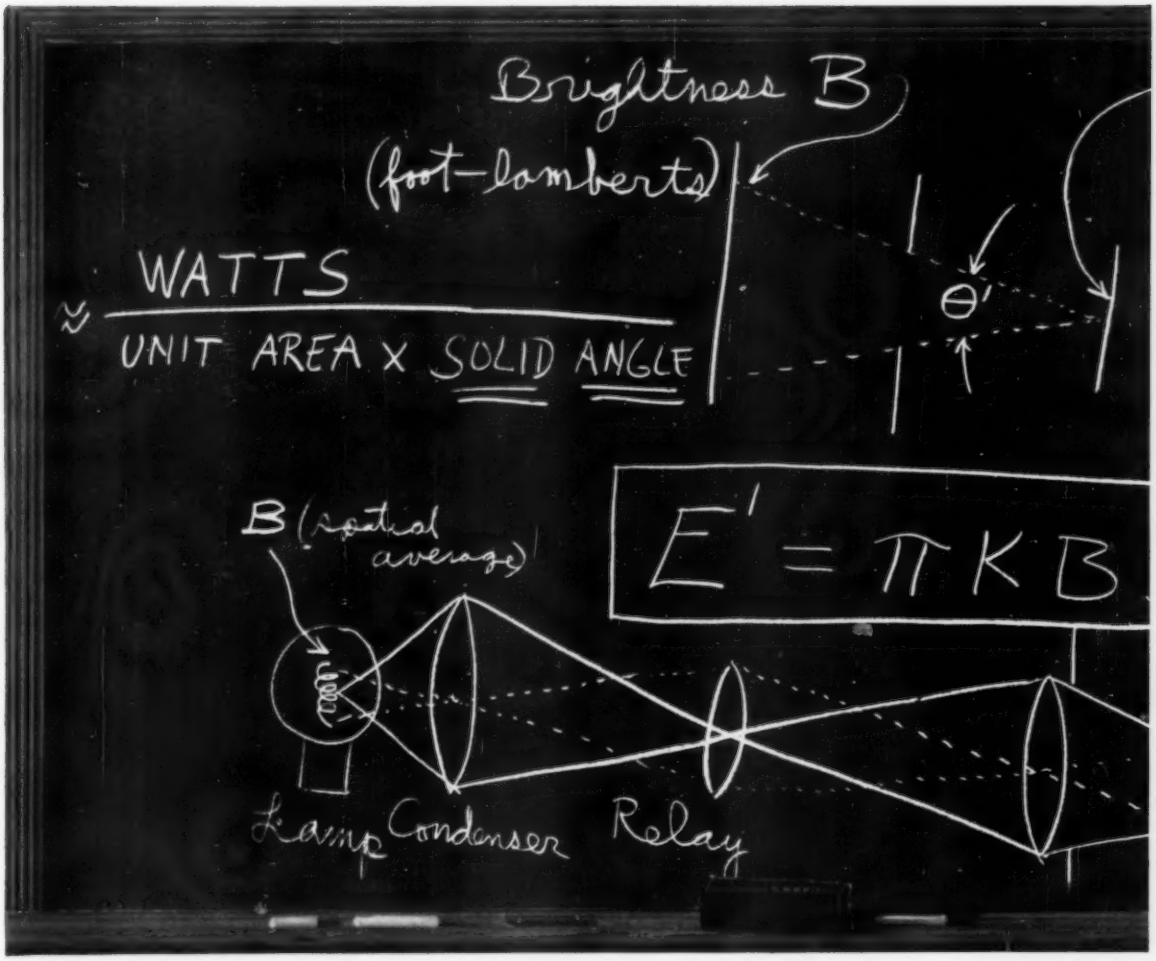
Visual aids, such as slides and motion-pictures can be integrated in the teaching program for the day by having the slides and/or films set up in advance and making a notation in the script given to the director so that he can switch in the designated visual aid at the indicated time, thus eliminating all delay and distraction. Visual aids, such as charts and diagrams are also frequently used. These are placed in the studio and are under the control of the instructor.

Other educational TV highlights are reported each month in the **RCA Educational TV News.** Issue No. 47 notes the fifth anniversary of the Hagerstown project in Washington County, Md. No longer an experiment, the school board has approved a budget which includes all expenses for the educational TV program. At present 26 courses are being televised and sent into classrooms for 16,500 students in all grade levels.

And Issue No. 48 (February 1961) reports that more than 50 bills affecting television (and radio) were introduced during the opening days of the 87th Congress. Senator Magnuson (D. Wash.) reintroduced his ETV-aid bill, co-sponsored by Sen. Schoeppel (R. Kans.). Also, *TV Digest* reports that two new ETV stations, KAET (Chan. 8) Phoenix, Ariz., and KOAP-TV (Chan 10), Portland, Ore., will go on the air in 1961, bringing the total of educational on-air stations to 54.

A report from the University of Miami on radio, television and film activities covering the fiscal year from June 1, 1959, to May 31, 1960, showed 18 radio TV-film courses taught during the first semester for a total of 56 credits. Sixteen courses were taught during the second semester for a total of 48 credits. Average student enrollment per class was 21 students. Radio program series were produced for local radio stations and, for the first time since 1952, a University-produced television program series was supported by commercial sponsorship. Chase Federal Savings and Loan Association sponsored a series of

Your name came up during this chalk talk



Many ideas to serve our customers better are born on blackboards. We constantly review our basics, constantly strive to improve our techniques. Only in this way can we continue to offer you superior quality and service in color motion picture production. Forty-five years of experience mean the kind of dependability that saves you time and money.

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four programs on the progress of medical research. Offering of credit for a course in Freshman English broadcast over the educational TV station WTHS-TV was inaugurated on an experimental basis in 1959. In the Summer of 1960 a more extensive educational program was broadcast, financed by a grant from the Office of Education under the National Defense Education Act. The experiment was planned to provide means of evaluating the advantages of open-circuit television as a means of bridging the gap between high school and college.

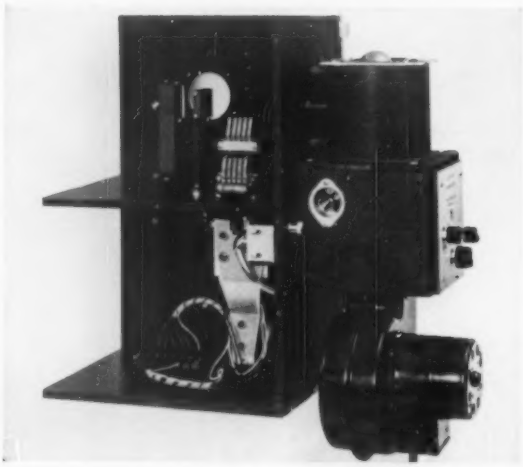
A course in *A General Survey of Animation*, which began February 6, extending thereafter through 16 meetings, has been announced by the University of Southern California, Los Angeles. The course, offered by the USC Cinema Dept. in cooperation with the Hollywood animation industry, is open to applicants on professional and student levels and also to representatives of firms using or having an interest in animated films. The course is being taught by Gus Jekel, President of Film Fair, who was formerly associated with Disney Studios. Other courses offered by USC which deal specifically with animation include Animation Art; Animation Layout; Story and Story Sketch for Animation; and Animation Scene Planning and Camera Technique.

Responsibility for achieving and maintaining high standards for television broadcasting in Japan has been accepted by the Motion Picture Engineering Society of Japan. A report in a recent issue of the *Journal of the M.P.E.S.* outlines the rapid progress of television in Japan since its introduction in 1953. At present, the report states, the NHK, the Japanese Broadcasting Corp. (Nippon Hoso Kyokai), maintains more than 60 local stations on the nationwide network and about 42 commercial broadcasting companies are in operation. Fears have been expressed that progress in the quantity of television facilities would outstrip the quality. Following preliminary meetings, the M.P.E.S. appointed, in October, 1960, a Committee for the Improvement of the Quality of TV Films. Two subcommittees have been appointed, one on picture quality and the other on sound quality.

MODULATOR and LIGHT SOURCE For Depue-Carlson Step Printer

MODEL R-BW

Equipped with 1000 Watt adjustable lamp house



Overall size: 20x20x10"
Net weight: 70 lbs.
Price: $3,000
f.o.b. New Rochelle, N.Y.
Packing and crating extra

This highly efficient optical system provides uniform light on the 35mm aperture of the Depue-Carlson Transport. A cold mirror of the effective interference type and a heat absorber are used so that very little heat reaches the printing aperture.

Modulation of the light is achieved by means of 5 AC solenoid actuated neutral density glass filters, giving 32 printer steps in increments of .025 or .030 Log E. The black-and-white model is supplied with a blue trimmer and 5 neutral glass filters calibrated for blue light.

Contained in the optics housing are a special shutter and lamp house position sensing switch.

The lamp house is designed for a 1000-Watt T-12 bulb with blower. Bulb alignment is easily made in darkness simply by adjusting 3 knobs which provide for vertical, transverse and rotational motion of the bulb. A damping cylinder prevents mechanical shock to lamp filament during opening and closing.

A mounting block and hinge plate are supplied for attachment to the Depue-Carlson Transport Model 3-K #50. Similar mounting is available for older models.

This unit is adaptable to automatic control using punched tape or modified drop board.

WRITE FOR FURTHER INFORMATION

FISH-SCHURMAN CORPORATION, 85 Portman Road, New Rochelle, N.Y.

A new firm, the Optical Printing Service, Inc., has been established at 2908 Bowser, Dallas 4, Tex., and an Acme Optical Printer has been installed. The firm offers 35mm to 16mm; 16mm to 35mm; and 35mm to 35-mm color and black-and-white optical printing as well as all types of optical effects. Manager of the new firm is John Bronaugh.

The American TV Commercials Festival will be held May 4, 1961, at the Hotel Roosevelt, New York. Competition in the "Current" category is open to commercials shown on TV in the United States or Canada during the period from March 31, 1960, through March 1, 1961. Competition in the "Classics" category is open to outstanding commercials first shown during or before 1955. Awards include Certificates of Recognition to be presented to 150 commercials selected for showing at the Festival. Other awards include special citations for advertising achievement and for craftsmanship. Further information is available from Wallace A. Ross, Festival Director, American TV Commercials Festival, 40 E. 49 St., New York 17.

A complete closed-circuit television system, with a 29 by 35-ft studio, is to be installed in the Air Force Headquarters in the Pentagon. The engineering, manufacturing and installation have been contracted for with Foto-Video Electronics, Inc., 36 Commerce Rd., Cedar Grove, N.J. Twelve rooms outside the main studio area will be fed audio-video programs for 16 color monitors. The studio will be equipped with a complete control room for all types of programs both audio and visual. At one end will be a long window above which will be installed six 14-in. monitors, two for monochrome, two for films, and two for color. All controls will be at desk level, including microphones and controls for studio sound and talk-back circuitry, and also monochrome and sound cameras. Audio, special effects panels, video switching, a patch identification panel with remote sync control, power supplies and other equipment will be installed in the rear. The main equipment room will be adjacent to the studio. A 60-ft amphitheater, one end of which will be used as a conference area, will have a color television projector and four direct-view monitors. A large conference table will be in viewing distance of a 20-ft wall screen. Eleven other conference rooms will be equipped with video-sound

Latest advice on b&w neg for instrumentation

Kodak Royal-X Pan Recording Film, given the proper development such as 8 minutes in Kodak Developer DK-50, is the fastest material we have. This holds true both for hand-camera exposure times and for the very short exposure times of high-speed instrumentation. It holds true even when only green light is used, as in recording from certain c-r tubes. Royal-X Pan is very good to have when you need every bit of sensitivity you can get, but it is grainier than other Kodak films. Furthermore, in a high-contrast developer such as Kodak D-19, its speed advantage over other good Kodak recording films shrinks and disappears altogether for high contrast and very short exposure times.

Very recent advances in emulsion technology have produced the new **Kodak Double-X Panchromatic Negative Film.** For very short exposure times and 8 minutes in Kodak Developer D-19, it is just about as fast as Royal-X Pan Recording Film, but its graininess is much less—on a par with the fine grain and sharpness formerly attainable only in comparatively slow films.

Another film worth considering for instrumentation work is **Kodak Linagraph Ortho Film.** Its speed has recently been nearly doubled. Special attention has been given to constancy of properties during storage before use. It is a high-contrast film, designed for development to a gamma as high as 1.9. If you want high contrast for very short exposure to green light, Linagraph Ortho Film is your ticket.

All of which tells you nothing of the physical forms in which you can get these and many other Kodak films for instrumentation. Better ask for the capsule-summary sheet "F3-297" from

EASTMAN KODAK COMPANY
Photorecording Methods Division
Rochester 4, N. Y.

Kodak
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monitors. Five conference rooms will be equipped for use as monochrome camera studios and in addition will have direct-view color TV monitors. Two television tuners will be included for off-the-air pick-up of commercial color or monochrome programs.

It will be possible to switch electronically the eight video signal sources covered by the installation to any one or all of 16 points through coaxial cables. Keyed-clamp devices in the stabilizing amplifier circuitry will also have the effect of removing noise. Before going to the direct-view 17-in. monitors in the two main conference rooms, connecting cables are split by special distribution amplifiers to improve stability of images. This method is substituted for the use of "bridging" units to avoid the possible introduction of phase distortion that would have the effect of deteriorating color reproduction. An output patching panel automatically selects the appropriate distribution point of the 16 distribution points and inserts the proper distribution amplifier.

Two sychronizing systems are provided to accommodate simultaneous off-air, electronic tape pickup, color, film, and live programming. A number of newly developed devices will be used in the installation. One of these is a device that prevents a monitor being turned on unless an interrelated series of events has occurred. This device prevents any unauthorized point from receiving classified information.

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The Photo Research Corp., 837 North Cahuenga Blvd., Hollywood 38, has signed a $50,000 contract with the Federal Aviation Agency for the Spectra Brightness Spot Meter, it was announced by Karl Freund, President of Photo Research. The meter won an Academy Award Class 3 Certificate for scientific and technical achievement in 1955. It was originally designed to measure telescopically the brightness of motion-picture screens. The FAA plans to use the instrument in its newly developed bright-display system because of its ability to measure an area as small as 0.015 in.

Dr. Freund also announced that his firm had inaugurated a profit-sharing plan for the benefit of its employees.

Plans for producing magnetic recording tape, production to begin later this year, have been announced by Eastman Kodak Co. Initially the tape will be supplied for professional and amateur sound recording uses. It will be on triacetate base and packaged in rolls ¼-in. wide in standard lengths. It is expected that the company will, eventually, produce a complete range of magnetic tapes for various applications such as instrument recording and electronic computing.

Howard Karp & Co., 23 Haven Ave., New York 32, has been appointed the representative of E. & W. Bertram Co. of Munich, Germany, for the sale of Bertram Electric Eye automatic camera exposure controls and devices. Bertram instrument components are used in a number of still and motion-picture cameras manufactured in the United States and in Germany.

Neal Keehn has been appointed Vice-President in charge of Sales for General Film Laboratories, Hollywood. Announcement was made by William E. Gephart, Jr., President. Prior to his present appointment Mr. Keehn served for two years as Regional Vice-President in charge of the Central Division office in Kansas City. In his new post he will have charge of the firm's advertising and sales promotion, as well as sales, and he will continue as Editor of the firm's monthly publication *Rewind*. Mr. Keehn was previously Sales Vice-President for the Calvin Co., Kansas City, and was Director of the Calvin Workshop from its organization in 1947 through 1959.

Charles E. Cripps has been appointed East Coast Technical Representative for Houston Fearless Corp. with headquarters at 1411 K St., N.W., Washington 5, D.C. He was transferred to Washington, D.C. from the firm's plant in Los Angeles. In his new post he will have charge of installation of laboratory equipment manufactured by the firm's Westwood Division.

T. L. Jacobsen has been appointed Sales Manager for Westrex Corp., a Division of Litton Industries, 6601 Romaine St., Hollywood. He was formerly Eastern Sales Manager for Westrex and has had many years experience in electronic design, project administration, product planning and marketing.

but we would like to remind you—

That Hunt photographic grade chemicals have been rigidly controlled to comply with ASA specifications since their introduction.

That this is Hunts' long standing policy and not a "Johnny-come-lately" idea.

That Hunt packaging is time tested and unsurpassed in the industry, incorporating such features as color-coded bags for easier chemical identification.

That Hunt has been the principal chemical supplier to the motion picture industry since 1909.

That this is the best possible testimony to Hunt quality and service.

For service that is unsurpassed—Contact your nearest Hunt office

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Obituaries

Lloyd Thompson

Lloyd Thompson died of a cerebral hemorrhage December 24, 1960 in Kansas City, Missouri at the age of 51. He was Executive Vice President, co-owner and co-founder of The Calvin Company, Kansas City, Missouri.

A member of the SMPTE since 1934, made a Fellow in 1951, a former member of the Board of Governors, Progress Report Chairman for the past five years, he was Editorial Vice President Elect at the time of his death. Lloyd had long served on the Standards Committee and was active in the founding and work of the Association of Cinema Laboratories. He wrote and presented numerous papers for the Society and was the author of many articles for magazines of the industry and other publications interested in things photographic.

He was born at Eskridge, Kansas, the son of a prominent cattleman and rancher of that place. Long before his graduation from Harneyville Rural High School he showed great interest and creativity in things both mechanical and electrical but went on to take a degree in journalism from the University of Kansas at Lawrence in 1932. During his college years he was fascinated with photography as a hobby and became more and more interested in the possibilities of commercial movies as a profession. Using a 16mm Bell & Howell camera he photographed the Kansas University football games in 1931 and 1932 and during his senior year made a commercial motion picture on refrigerators for a Lawrence firm.

He had spent one summer studying photography at Lake Geneva, Indiana, and immediately following graduation in 1932 he came to Kansas City to join forces with Forrest and Betty Calvin who were operating an advertising company. Thus began the producing organization and laboratory now nationally known as The Calvin Company.

The story of the growth of the company is the story of Lloyd Thompson. A firm believer in the future of the direct 16mm method of producing commercial and educational films, he spent long hours at research and experimentation in all the facets of the media. First there was the problem of better photography and processing, better and faster printers, then sound for direct 16mm and the constant struggle to improve its quality. Each year he developed or adapted new machines and processes to better the films and laboratory services. Many of his ideas have become standards for the industry. However, it was characteristic of him that he never said or would want it said now that he alone should take complete personal credit for many of these achievements. He was always fully cognizant and grateful for the cooperative help he had from the men of his company's laboratory and engineering shop as well as many colleagues all over the country.

Truly a pioneer in the 16mm field and constantly working to improve methods, machinery and quality he also believed there was a place for sound on 8mm. In the middle forties he developed and put on the market through his own company, Continental Products Inc., the Movie-Sound-8 projector. This was an 8mm projector with the sound on a disc, started by an electrical impulse on the film. Not satisfied with this, he designed and developed the Movie-Sound-8 with the sound on the film made possible by magnetic striping. This machine was manufactured by the Movie Mite Corporation and later by The Calvin Company. Through the development of these machines Mr. Thompson acquired several patents.

Preferring colored slides to movies for his personal travel pictures he tried many ways to improve them. In 1955 he adapted a camera with a CinemaScope-like lens to make wide-screen slides. The results were beautiful pictures that attracted a great deal of attention.

After twenty five years in the motion-picture business Mr. Thompson in 1957 was invited to become a member of the Motion Picture Pioneers of America. He personally has been the recipient of several awards, as has The Calvin Company.

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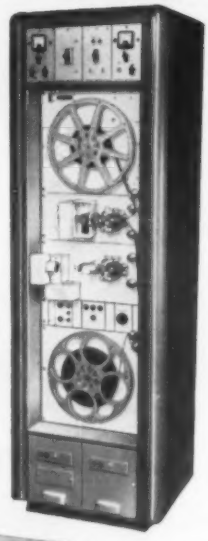
Gaumont-Kalee Rack Mounted Optical and Magnetic Reproducer—35 mm. and 16 mm. types available; also rack mounted and portable magnetic recorders.



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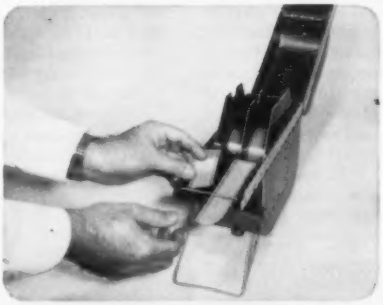

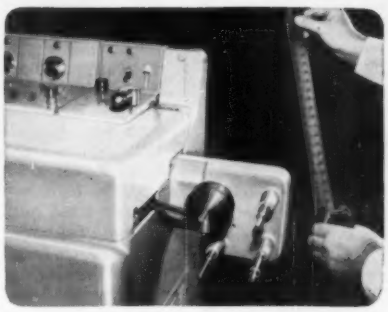

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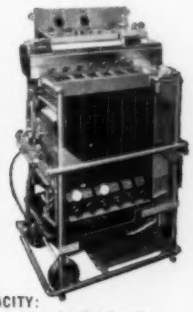
The Mark 3 Automatic Tri-Film Processor develops and dries 16, 35 and 70 mm. film at 1½, 3 or 6 feet a minute. Separate temperature control of the processing solutions from 60 to 110 degrees F. is possible within ±1 degree. Processing is controlled by a mechanical program unit after the film is daylight loaded, and positive squeegee rollers reduce the need of stop baths and interbath rinses. The processor is perfect for newsreels, motion picture rushes, microfilm and all types of negative/positive cinematography where speed plus quality is essential.



CAPACITY:
16 mm. 1 to 4 rolls } length
35 mm. 1 to 2 rolls } to
70 mm. 1 roll } 400 ft.

PROCESS RATE: 1½, 3 or 6 ft. a minute.

SPECIFICATIONS
SIZE: 54" long, 22" wide, 51" high
WEIGHT: 550 lbs.
POWER: 5KVA maximum single-phase: 110 volts, 45 amps., or to customer requirements.

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For twenty-five years, too, his home workshop has been the continuous scene of new ideas on a drafting board, or the "bread-board model" of a bit of new equipment he felt might be interesting to develop. Many were discarded as impractical or unworkable, but there was also a fine percentage of successes. He left several unfinished projects for he believed in the future of the business he loved and the new developments and techniques modern science was making possible for the motion picture and television industry.

John V. L. Hogan

John V. L. Hogan, 70, died December 30, 1960, at his home in Forest Hills, Queens after a long illness. A pioneer in radio, and later in television, he was associated with Lee De Forest in 1906 and assisted him in experiments with the audion and radiophone. From 1908 to 1910, he attended the Sheffield Scientific School at Yale University where he specialized in physics, mathematics and electric waves. From 1910 to 1914, he was telegraph engineer of the National Electric Signaling Co., and in 1912 he founded the Institute of Radio Engineers. During World War I, he assisted in the production of radio outfits for warships and aircraft. In 1918 he was appointed Manager of the International Radio Telegraph Co. and served as Chairman of the Radio Engineers Committee on National Defense. In 1921 he went into business for himself as a consulting engineer and began a long series of experiments in television, frequency-modulation radio and facsimile transmission.

His early interest in television was described in a paper at the Society's 1954 Spring Convention at Washington, D.C., and published in the November 1954 issue of the *SMPTE Journal*. In this paper, "The Early Days of Television," he described the antecedents of modern television from 1875 to 1930. In this paper he mentioned his own broadcasting station W2XR (later, WQXR) over which, as early as 1929, broadcast pictures scanned at 60 lines/frame and 20 frames/sec. Mr. Hogan set 1930 as the date which marked the end of "early" television and the beginning of the modern era of television.

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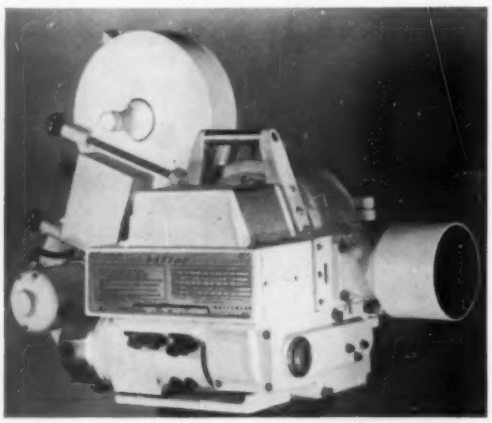

You get truly superb resolution—blur-free pictures at highest speeds—with the WF-8A 35mm Full Frame Metric High Speed Camera.

And so easy to use! No changing of motors and gears for different speeds, because unit is completely self-contained. Just load up and shoot at any of 8 speeds from 200 to 2000 p/p/s. You'll see more detail on the film than ever before . . . in full frame size!

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WF-1—100' Motion Picture
WF-2—400' Motion Picture
WF-2S—400' Motion Picture Stop-start
WF-19—400' Combined Motion Picture-Oscillo-Streak
WF-19S—400' Combined Motion Picture-Oscillo-Streak Stop-start
WF-21—100' Combined Motion Picture-Oscillo-Streak
S—Stop-start

16mm CAMERAS
WF-3—100' Motion Picture
WF-3T—100' Motion Picture
WF-4—400' Motion Picture
WF-4T—400' Motion Picture
WF-4S—400' Motion Picture Stop-start
WF-4ST—400' Motion Picture Stop-start
WF-6—100' Oscillo-Streak
WF-14—400' Combined Motion Picture-Oscillo-Streak
WF-14T—400' Combined Motion Picture-Oscillo-Streak
WF-14S—400' Combined Motion Picture-Oscillo-Streak Stop-start
WF-14ST—400' Combined Motion Picture-Oscillo-Streak Stop-start
WF-17—100' Combined Motion Picture-Oscillo-Streak
WF-17T—100' Combined Motion Picture-Oscillo-Streak
WF-22S—400' Oscillo-Streak, Stop-start
WF-23—400' Oscillo-Streak

35mm CAMERAS
WF-5—100' Motion Picture, ½ Frame
WF-7—100' Oscillo-Streak, ½ Frame
WF-8—500' Motion Picture
WF-8A—400' Motion Picture Metric Camera
WF-9—100' Combined Motion Picture-Oscillo-Streak
WF-10—400' Oscillo-Streak, ½ Frame
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The control unit consists of a variable AC transformer capable of outputs up to 280 volts which permits maximum operating speeds. In addition, a set of electrical timers make possible synchronization between the camera and event being photographed.

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with Control Console. Portable, rugged, highly efficient. Operates from low voltage DC supply . . . has high percentage of light collection, and color is exactly comparable to daylight. Pictures can be taken as fast as 16,000 pps on color film ASA8.

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Arthur C. Downes

Arthur C. Downes died February 11, 1961, at the age of 79. He joined the Society in 1927 and was made a Fellow in 1934. He was elected Editorial Vice-President in 1941 and served through 1946. During that time he also served as Chairman of the Board of Editors. He was born in Ipswich, Mass., in 1882, and was graduated from the Massachusetts Institute of Technology in 1904 with the degree of Bachelor of Science.

Following a year spent as a chemist with the Hartford Laboratory Co., he joined National Carbon Co., and remained with that firm at various locations and in various posts until his retirement in 1947. From 1925 until his retirement he was head of the firm's Research and Development Laboratory. In 1928 he was presented with an award by the Academy of Motion Picture Arts and Sciences for his work in illumination research. Scientific societies of which he was a member included the Illuminating Engineering Society, where he held the rank of Fellow, the American Chemical Society and the American Institute of Chemical Engineers. An extensive Biographical Note was published in the March 1952 issue of the *Journal* (p. 266).

He is remembered by Society *Journal* readers for his maintaining the Society's publication through World War II and then for establishing rigorous publishing standards. He was Chairman of the Board of Editors until 1955.

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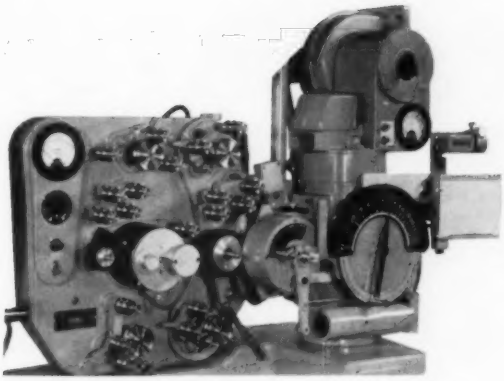

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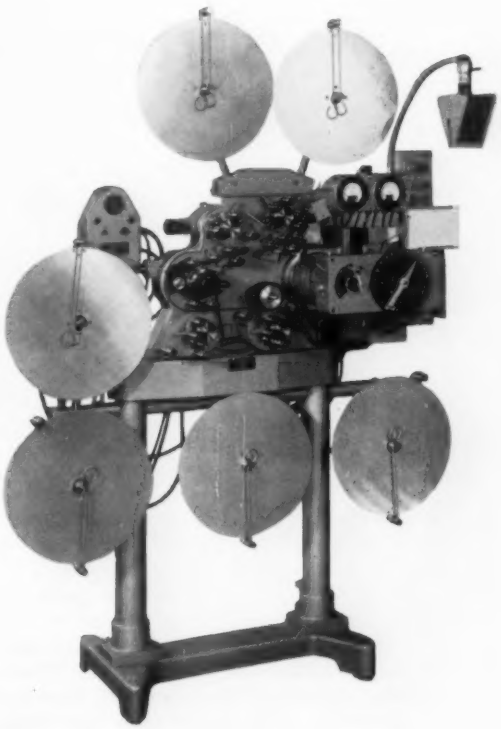

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Cameras and Equipment (Except High Speed)
Color Photography and Color Development
Film and Its Properties
Film Processing Apparatus and Chemicals
High-Speed Photography and Instrumentation
Printing and Optics
Projection
Sensitometry and Image Structure
Television
Videotape

CAMERAS AND EQUIPMENT (Except High Speed)

Discussion on Contemporary Forms of Cinematography and Possibilities in Their Development (In Russian), *Tekh. Kino i Televideniya, 4:* 86–94, September 1960.

Papers presented at a two-day discussion held in Leningrad in May, 1960, are summarized. The subjects covered were the various systems of panoramic, wide-screen, and wide-format cinematography and their application under the conditions of the Soviet industry. There was general agreement on a number of points including the following:

The most promising of the new forms is a system using wide-gage (70mm) film. The rapid development of other forms of cinematography does not decrease the importance of normal 35mm cinematography (in both color and black-and-white) which will remain the basic form for mass distribution for some time to come. The most successful of the wide-screen systems at the present stage of development is that using anamorphic images on 35 mm film. Concentration on the scientific and technical aspects of the new forms of cinematography has in the past deflected attention from the solution of the problems arising in the improvement of the quality of the 35mm and wide-screen cinematography at present in use. It is necessary to pursue these lines and also to concentrate on the elaboration and manufacture of all types of equipment and apparatus required by the new systems. More extensive work must be carried out on the exhibition of films, i. e., such problems as viewing conditions, type of screen and angle of viewing.

Finally, it was decided that steps should be taken to improve the collaboration between workers in different sections of the industry.—S.C.G.

New Motion-Picture Techniques (in Russian), I. B. Gordiĭchuk, *Tekh. Kino i Televideniya, 4:* 1–10, Sept. 1960.

A review is given of new forms of motion-picture apparatus and techniques whose design was finished in the Soviet Union during the years 1959 and 1960. A number of motion-picture cameras are described for ordinary cinematography, for use with 70mm film and for wide-screen and panoramic cinematography. A range of new lenses includes some for use with ordinary 35- and 16mm cameras, and also special lenses for use with wide-format films and for wide-screen cinematography. Other apparatus for the film technician includes a television viewfinder which allows the scene being filmed to be viewed simultaneously on several screens, a versatile camera crane, a single-frame projector for wide-format films for use in special-effects work, a double-exposure device and an optical printing machine.—S.C.G.

Cinematographic Systems of the Future (in Russian), E. M. Goldovskiĭ, *Tekh. Kino i Televideniya, 4:* 9–19, June 1960.

Consideration is given to the state of development in the new system of cinematography in the Soviet Union and abroad, and paths of investigation for the foundation of perfect systems of photography for the future are indicated. An attempt is made to work out the most important parameters in a cinematograph performance, and the difference between that and a cinematograph "attraction" is set out. For discussion, the question of an intermediate system of cinematography for the future is proposed, together with ways by which it could be brought about.—S.C.G. (Translation of Author's Abstract)

The Photography of Dynamic Background Sets (in Russian), Ya. L. Leĭbov, *Tekh. Kino i Televideniya, 4:* 74–75, June 1960.

In the photography of background studio sets in which motion occurs, great care is

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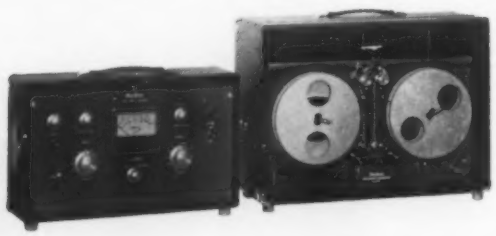

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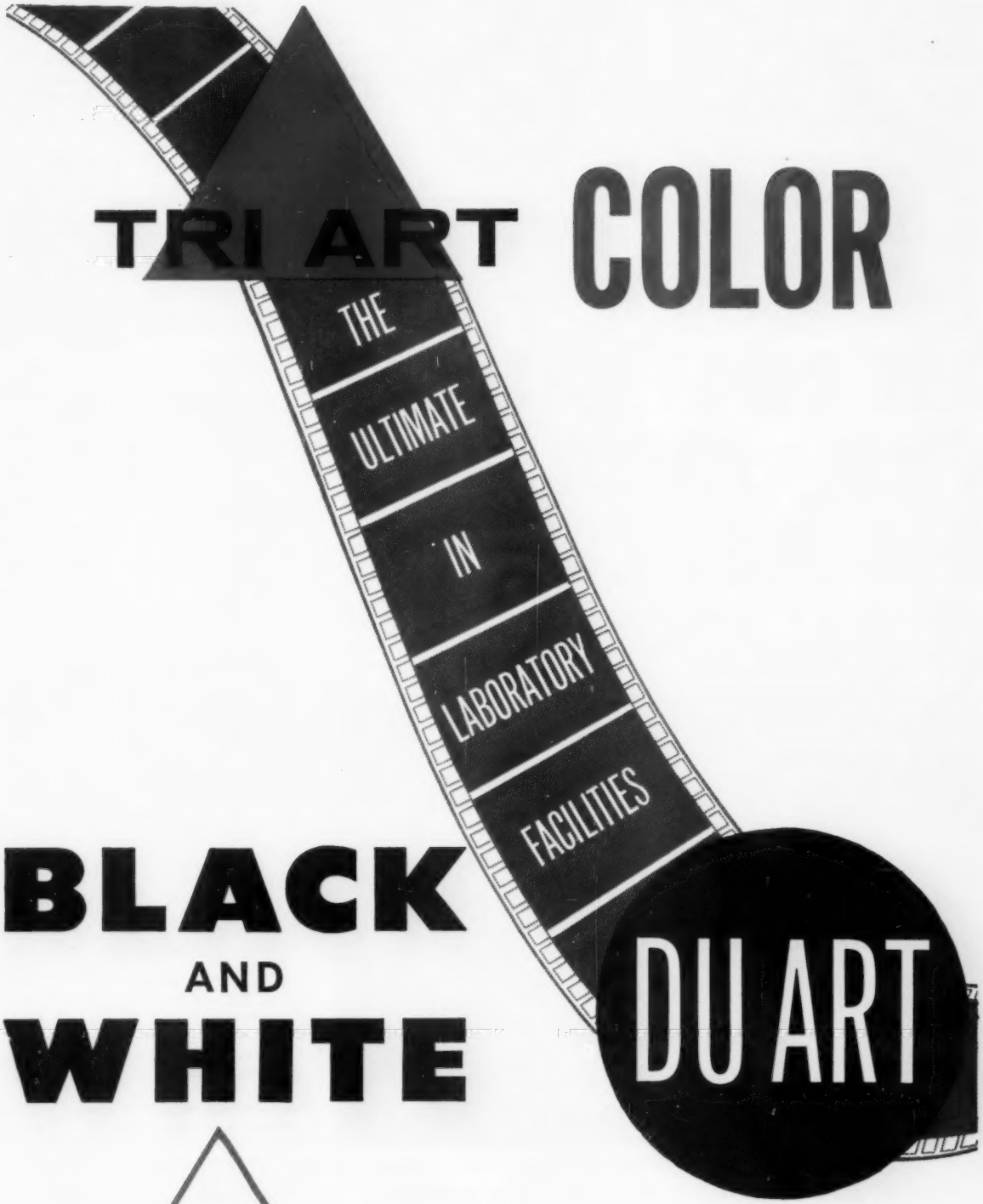

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required to make the final picture look natural. The geometry of the situation is discussed and recommendations are made for filming this kind of set.—S.C.G.

The Choice of the Optimal Parameters in Stereocinematography (in Russian), A. N. Shatskaya, *Zhur. Nauch. i Priklad. Fotografii i Kinematografii, 5:* 195–206, No. 3, May–June 1960.

Adherence to the physiological criterion—the zone of stereoscopic depth—is the most important factor in stereocinematography, determining a good stereo effect and stereo vision without strain. The optical base for photography must be chosen so as to maintain the zone of stereoscopic depth. Two formulas are derived which fulfill this condition. The position of the footlight plane (i.e., the apparent plane in the stereoscopic picture which appears to coincide with the plane of the screen) during exposure can be conveniently determined, starting from the distribution of important objects in the subject field and dividing the overall difference in horizontal parallax into two. Two formulas are derived to allow the calculation of the distance of such a footlight plane.—S.C.G. (Adapted from Author's Abstract)

Soviet Books on Photography, Cinematography and Related Fields of Knowledge in 1959 (in Russian), *Zhur. Nauch. i Priklad. Fotografii i Kinematografii, 5:* 239–240, No. 3, May–June 1960.

A bibliography of books produced in Russia during 1959 is given. It is the first of a series of periodic bibliographies.—S.C.G.

The Problems Arising in the Development of Stereoscopic Cinematography (in Russian), B. T. Ivanov, *Tekh. Kino i Televideniya, 4:* 1–9, July 1960.

The author, a pioneer of Soviet stereoscopic cinematography, asserts his conviction that wide-screen and panoramic systems do not give a sufficiently natural representation of three-dimensional scenes, and gives his views on the future of true stereoscopic cinematography.—S.C.G.

COLOR PHOTOGRAPHY AND COLOR DEVELOPMENT

A Printer for the Additive Printing of Color Films (in Russian), M. G. Shamshteĭn, B V. Valuĭskiĭ, A. K. Feĭst, S. N. Podlesnykh and R. U. Rud', *Tekh. Kino i Televideniya, 4:* 12–20, Aug. 1960.

A description is given of the UKA-T's color printer which has been designed by the NIKFI Research Laboratories in conjunction with the Moscow film-printing laboratories. The principle of the optical system is well known, the light being passed through three-color additive filters and then through a matte consisting of a strip of film in which are punched sets of holes to regulate the amount of red, blue and green light for each scene, and a similar strip of film at right angles to adjust the light for the color balance of the positive material, before being recombined at the film gate. The choice of filters and the illumination of the printing gate are discussed, and the matte-transport mechanism is described in some detail. In addition, a small device for preparing the mattes and backing filter strips is described—S.C.G.

Elimination of Errors in the Internal Masking of Color Multilayer Films (in Russian), Yu. B. Vilenskiĭ, Chen' Kuan-Min, L. F. Patrikeeva and E. I. Tul'chinskaya. *Zhur. Nauch. i Priklad. Fotografii i Kinematografii, 5:* 183–186, No. 3, May–June 1960.

The unwanted absorption of a dye used for color photography should be independent of the wanted absorption. When the wanted absorption of a dye is plotted against the unwanted absorption, full correction is represented by a straight line parallel to the axis of the wanted absorption. In practice, the relation is frequently a curve, owing to insufficient correction at low wanted densities and overcorrection at high wanted densities. Such distortion in masking occurs when correction is made by a mixture of masking and nonmasking couplers in a single layer and is due to their different reactivities. Full color correction can be obtained by putting the masking and nonmasking couplers into separate layers of emulsion, the sensitivities of which differ in such a way as to offset the difference in reactivities of the dyes.—S.C.G.

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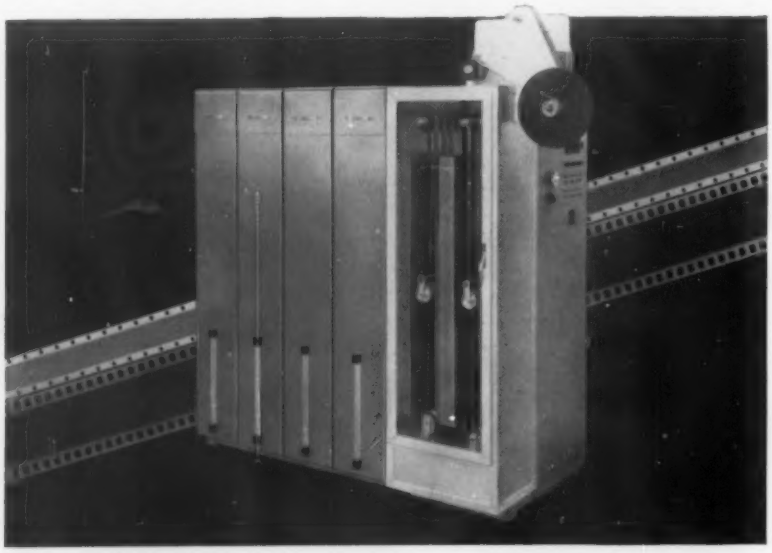

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Study of the Kinetics of Development of Color Positive Film at Different Temperatures (in Russian), N. I. Kirillov and L. P. Lysenko, *Zhur. Nauch. i Priklad. Fotografii i Kinematografii, 4:* No. 2, 84–89, Mar.-Apr. 1960.

Although manufacturers give directions for processing their film, batch-to-batch variations are sufficiently large to require modifications of the processing conditions in order to obtain standard sensitometric properties. The effect of such modifications has been studied for Agfa Type-5 color positive film. In addition to the processing temperatures, the concentration of the developing agent and the time of development were varied and their effects on the gamma and speed of the layers were studied. The effect of a preliminary hardening of the film for development was also studied. The data obtained form a basis for the modification of the color processing in order to obtain a constant speed and gamma.—S. C. G.

FILM AND ITS PROPERTIES

The Tension of Motion-Picture Films Caused by Friction in Photographic Solutions (in Russian), I. S. Golod, *Tekh. Kino i Televideniya, 4:* 39–40, Sept. 1960.

A mathematical analysis is made of the tension arising in a motion-picture film due to the drag of the liquid on passing through the tanks of solution in a developing machine. It is concluded that the tension in a normal- or narrow-gage film, passing through photographic solutions with lamina flow, in an average processing machine working at the rate of 2000 to 2500 m/hr, is 12 to 15 g. This has only a small influence on the total tension and corresponds to about 5% of the tension due to the drag of the film-carrying rollers. With turbulent flow, the viscous drag of the solution may reach 120–150 g, or 40–50% of the tension due to the drag of the rollers.—S.C.G.

The Standardization of Motion-Picture Film Stock, Apparatus Elements and Developed Films for Wide-Gage Cinematography (in Russian), *Tekh. Kino i Televideniya, 4:* 68–69, Sept. 1960.

On Sept. 1, 1960, the following departmental standards, covering various aspects of 70mm motion-picture film and apparatus, came into force in the Soviet Union: NORM-KINO 2-60, 22-60, 23-60, 24-60, 25-60 and 27-60. The chief recommendations of these standards are summarized.—S.C.G.

FILM PROCESSING APPARATUS AND CHEMICALS

The Improvement of the Properties of Motion-Picture Films and Their Processing (in Russian), N. G. Trofimenko, S. E. Tikhonovich and B. A. Zaborovskii; Ya. A. Mikheev and M. F. Tokarev; and E. A. Rudman, *Tekh. Kino i Televideniya, 4:* 41–45, Sept. 1960.

In an article having the same title, E. A. Iofis (*Tekh. Kino i Televideniya, 4:* 33, Jan. 1960) discussed a number of problems affecting workers in the Soviet motion-picture industry. Further additions to the discussion are presented. The first three authors of the present paper draw attention to the lack of up-to-date equipment and suggest a number of improvements as an immediate short-term program. The next two authors point out that the large-scale automatization envisaged by Iofis is not applicable in a number of smaller studios. Desires for improvement in motion-picture studios and processing laboratories are also set forth by the last author.—S.C.G.

Influence of the Concentration of Developing Agents on Rapid Development. II. Study of the Hydroquinone Developer (in Russian), V. A. Veldenbakh and P. I. Levina, *Zhur. Nauch. i Priklad. Fotografii i Kinematografii, 5:* 241–246, July-Aug. 1960.

In Part I (*Zhur. Nauch. i Priklad. Fotografii i Kinematografii, 5:* 20, 1960), the action of Metol was found to be not completely explicable by the electrochemical theory of development. It seemed possible that this was because the uncharged amino groups were capable of penetrating the charge barrier and adsorbing onto the silver halide surface. Experiments have now been carried out with hydroquinone, which possesses two negatively charged groups in the para positions. The results

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obtained differ significantly from those with Metol. The differences are shown in the form of the density vs. log-concentration curves for the developing agents, and by the restraining action of potassium bromide on the hydroquinone. There was no difference in the mechanism of fog formation with the two developers.—S.C.G.

Machine for Removing the Emulsion Layer from Film Copies (in Russian), V. Mishchenko, *Kinomekhanik*, 38–40, Mar. 1960.

The machine described is intended for the mechanical removal of the emulsion layer from unwanted film prints in order to provide a clean base for use as a leader strip. The machine can be used for 35- and 16mm prints and is intended for use at film-distribution centers—S.C.G.

HIGH-SPEED PHOTOGRAPHY AND INSTRUMENTATION

Testing of Photographic Shutters by Slit Photography and Some Points in the Operation of Between-the-Lens Shutters (in Russian), (Translated from *Tekh. Kino i Televideniya.*) E. T. Dubatovko, *Optiko-Mekhan. Prom.*, No. 1, 23-60, 1960; *Tekh. Kino i Televideniya, 4:* 81, Sept. 1960.

Methods are described for determining the characteristics of photographic shutters with the aid of a drum camera with a slit, and some points in the operation of between-lens shutters are discussed.

Consideration is given to the following problems: the determination of the dimensions of bundles of rays leaving the objective and falling on different points of the image plane; the determination of the characteristics of blind shutters with peripheral action; the determination of the characteristics of disk shutters with peripheral action; points in the operation of between-the-lens shutters and problems of the determination of their characteristics: and the determination of the characteristics of "Venetian-blind" shutters.—S.C.G.

Apparatus for High-Speed Cinematography (in Russian), (Translated from *Tekh. Kino i Televideniya.*) *Informatsionnyi Sbornik NIKFI*, No. 3, 11–16, 1960; *Tekh. Kino i Televideniya, 4:* 78, Sept. 1960.

Technical data are given for Soviet-produced high-speed motion-picture cameras, flashlight sources and auxiliary apparatus used in high-speed cinematography, and for analyzers for 16- and 35mm motion-picture films. Information is given on the basic types of Soviet-produced black-and-white and color films and on high-speed motion-picture cameras imported from the German Democratic Republic.—S.C.G.

Proceedings of a Conference on High-Speed Photography and Cinematography Leningrad, November 12–15, 1957 (in Russian), *Uspekhi Nauch. Fotografii, 6:* 1–223 (whole issue), 1959.

Individual papers presented at the conference have been abstracted separately.—S.C.G.

Terminology in the Field of High-Speed Photography and Cinematography (in Russian), A. A. Sakharov, *Uspekhi Nauch. Fotografiii 6:* 218–220, 1959.

Suggestions are made for the compilation of a glossary of accepted terms used in high-speed photography and cinematography for Russian use. Tables are given attempting a classification of the methods of high-speed photography and of the types of image obtained.—S.C.G.

The SFR High-Speed Streak Camera (in Russian), V. B. Likorenko, *Uspekhi Nauch. Fotografii, 6:* 130–138, 1959.

The SFR camera, in regular production in the Soviet Union, consists of a motion-picture camera with interchangeable parts so that it can be used either as a streak camera giving continuous scanning of the process under study with a time resolution of up to 10^{-8} sec (with an image-scanning speed on the film of up to 3750 m/sec), or as a high-speed motion-picture camera giving a sequence of photographs with a taking frequency of up to 2.5×10^{6} sec (with a mirror rotating at the rate of 75,000 rpm).—S.C.G.

Extending the Operational Possibilities of the SKS-1 Motion-Picture Camera (in Russian), S. V. Ryllo, *Uspekhi Nauch. Fotografii, 6:* 141–144, 1959.

The SKS-1 camera, widely used in the Soviet Union, is a high-speed motion-picture camera taking 150–4000 pictures/sec on 16mm film. Modifications have been made in order to increase the taking speed. The voltage across the motor is increased during running by means of a mechanically operated autotransformer, and the four-sided reflecting block is

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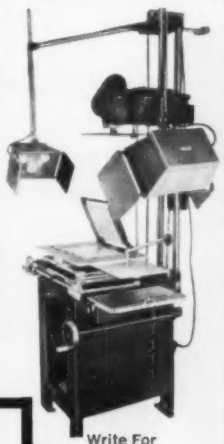

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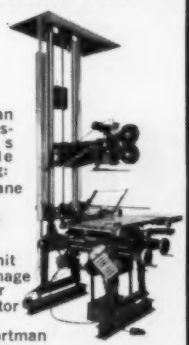

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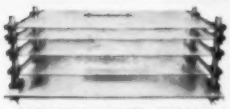

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Optical Accelerators and a New Design of High-Speed Motion-Picture Camera (in Russian), L. A. Samurov, *Uspekhi Nauch. Fotografii, 6:* 121–130, 1959.

The accelerators described, which are intended for increasing the rate of angular rotation of a beam of light, consist essentially of a number of mirrors rotating on a common axis with a number of stationary mirror elements, circular in form, grouped around the axis of the mirrors in such a way that multiple reflections are obtained. Such a system makes it possible to obtain a very high writing speed without approaching speeds of rotation of the mechanical parts dangerously close to destruction. A high-speed camera based on these principles has been designed.—S.C.G.

Some Problems in the Theory of Mirror Scanning (in Russian), A. S. Dubovik, *Uspekhi Nauch. Fotografii, 6:* 102–112, 1959.

The mode of action of a number of rotating-mirror systems is analyzed. The topics discussed are mirror scanning in streak cameras and high-speed motion-picture cameras, a rotating-mirror device to compensate for film movement and multiple reflection systems of the type described by Shnirman (G. L. Shnirman, *Uspekhi Nauch. Fotografii, 6:* 93, 1959).—S.C.G.

Some Problems in the Development of High-Speed Motion-Picture Cameras and Photochronographs with Mirror Scanning (in Russian), G. L. Shnirman, *Uspekhi Nauch. Fotografii, 6:* 93–101, 1959.

An analysis is made of the action of high-speed cameras with rotating mirrors. It is shown that increase in the length of the optical lever does not increase the time resolution, but a shorter optical lever can give lower resolution in practice with a real optical system. Time resolution is independent of dimensions of the mirror, but depends on the rate of rotation, which, in turn, is determined by the shape and mechanical properties. The case in which a number of intermediate focusing lenses are used in front of the sensitive material is also discussed. A device for increasing the speed of rotation of the light lever consists of two inclined mirrors rotating on parallel axes in opposite directions, the light being subjected to multiple reflections in the wedge-shaped gap between them. A camera using this device has been used in the Institute of Chemical Physics of the Academy of Sciences of the Soviet Union, and operates at a speed of 6 million frames/sec with a frame diameter of 12 mm, and up to 33 million frames/sec with a diameter of 5 mm. For recording a series of images of a rapidly occurring, self-luminous event, a combination of a four-sided rotating mirror with a drum carrying photographic material is used, which is described.—S.C.G.

Use of Electronic Elements in Apparatus for High-Speed Photography (in Russian) P. V. Kevlishvili. *Uspekhi Nauch. Fotografii, 6:* 91–92, 1959.

Brief mentions are made of the different ways in which electronic apparatus can be used in high-speed photography. These include synchronizing devices, shutters, measuring devices, control devices, timing devices and image-converter tubes.—S.C.G.

A Small Turbine Motor for High-Speed Streak Cameras (in Russian), S. N. Sidorov, *Uspekhi Nauch. Fotografii, 6:* 116–120, 1959.

On the basis of results obtained from testing turbine motors, it is possible to recommend the construction of a small, axial turbine motor for rotating a mirror with dimensions of 6 by 15 by 28 mm, with a frequency of 240,000/min, in photochronography or high-speed motion-picture cameras.—S.C.G. (Translation of Author's Abstract)

An Electrical Circuit for High-Speed Framewise Photography or Flash Discharges with the Aid of Image-Converter Tubes (in Russian), V. A. Simonov and G. B. Kutukov, *Uspekhi Nauch. Fotografii, 6:* 90, 1959.

Spark Equipment for High-Speed Photography on Stationary Film (In Russian), A. I. Salischev, *Uspekhi Nauch. Fotografii, 6:* 155–171, 1959.

Apparatus for spark photography is described that is capable of taking twelve

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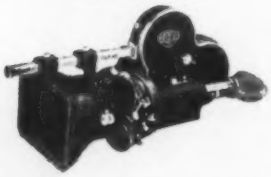

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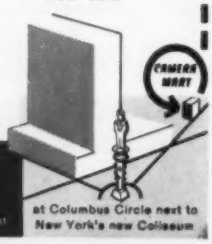

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pictures at the rate of 400,000 and 137,000/sec, at 0.24 natural size, the diameter of the object field being 110 mm. The apparatus consists of a bank of spark gaps operated in rapid succession by an electrical circuit, and a bank of objectives, each objective corresponding to one discharge gap. An optical system directs the light from each spark gap onto the object being photographed and thence to the appropriate objective.

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A Study of the Process of Cutting Metals by the Method of High-Speed Cinemicrography (in Russian), C. P. Tambovtsev, *Uspekhi Nauch. Fotografii, 6:* 174, 1959.

High-speed cinemicrography has been used to study a number of aspects of metal-cutting. The results of these investigations were reported in a lecture, a brief summary of which is presented.—S.C.G.

Use of High-Speed Cinematography for the Study of the Machining of Parts of Precision Apparatus (in Russian), N. I. Ryendenkov, *Uspekhi Nauch. Fotografii, 6:* 173, 1959.

A brief note summarizes a lecture at which a high-speed apparatus was demonstrated for studying the machining of parts of precision apparatus.—S.C.G.

Apparatus with Electronic-Flash Sources (in Russian), K. E. Monakhov, *Uspekhi Nauch. Fotografii, 6:* 200, 1959.

A brief report is given of a lecture and demonstration covering apparatus for the observation and photography of the flow of gas in aerodynamic tubes, and for the study of working machinery by stroboscopy.—S.C.G.

Use of High-Speed Cinematography with Electronic-Flash Sources in the Study of Aerodynamics and Rigidity of Rotating Elements in Aircraft Construction (in Russian), A. I. Khokhlov, *Uspekhi Nauch. Fotografii, 6:* 201–202, 1959.

A brief summary is given of a lecture. The characteristics of electronic-flash sources and of the Askania type of high-speed camera are outlined and the investigations in which they have been used are listed.—S.C.G.

A Study of the Free Flight of Grains by the Method of High-Speed Cinematography (in Russian), A. A. Kukibnyĭ, *Uspekhi Nauch. Fotografii, 6:* 202–205, 1959.

In a number of industrial processes, a granular material is projected for a distance through the air. The trajectories of such granular materials have been studied by means of high-speed cinematography of the grains against a reference network of horizontal and vertical strings.—S.C.G.

High-Speed Cinematography of a Flash Discharge in a Liquid Dielectric Medium with the Aid of the SKS-1 and SFR Cameras and Also with X-Rays, for the Study of the Dynamics of the Electro-Erosion of Metals (in Russian), V. N. Zolotykh and A. I. Kruglov, *Uspekhi Nauch. Fotografii, 6:* 185–192, 1959.

The photography of electro-erosion processes in light is difficult because the brightness of the discharge channel makes observation difficult. For this reason, high-speed studies with flash x-ray discharges were made in addition to those with ordinary electronic flash. The SKS-1 camera was used for frame frequencies up to 5000/sec and SFR-2M camera for frequencies above 40,000/sec. The electrical circuits used are described and the data obtained on electro-erosion are discussed.—S.C.G.

Study of the Mechanism of the Destruction of Rods Under the Action of a Shock Wave with the Aid of High-Speed Cinematography (in Russian), A. N. Khanukaev, *Uspekhi Nauch. Fotografii, 6:* 180–182, 1959.

In a study of rock-blasting methods, transparent plastic rods were used as models. A detonating charge was placed at the end and exploded, and the effect of the shock wave was studied by cinematography with an FP-22 camera operating at the frame speed of 98,600/sec. Results obtained at the frequency are discussed, and it is concluded that for further work a frequency of $0.5–2.5 \times 10^6$/sec is required.—S.C.G.

Some Results of an Investigation of Hydraulic Excavator Jets by Means of High-Speed Cinematography (in Russian) L. P. Severin, *Uspekhi Nauch. Fotografii, 6:* 183–184, 1959.

Study of Surface Boiling with the Aid of High-Speed Cinematography (in Russian), G. C. Treshchev, *Uspekhi Nauch. Fotografii, 6:* 213, 1959.

An abstract only of the original lecture is given.—S.C.G.

An Experimental Study of the Entry of a Body Into Water (in Russian), A. M. Rushaĭlo, *Uspekhi Nauch. Fotografii, 6:* 207–210, 1959.

Results obtained by high-speed cinematography are discussed.—S.C.G.

Use of High-Speed Cinematography for Studying the Process of Mechanization of Tea-Picking (in Russian), L. I. Markarov, *Uspekhi Nauch. Fotografii, 6:* 206, 1959.

An abstract only of the original lecture is given.—S.C.G.

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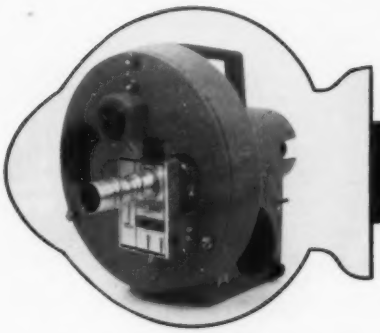

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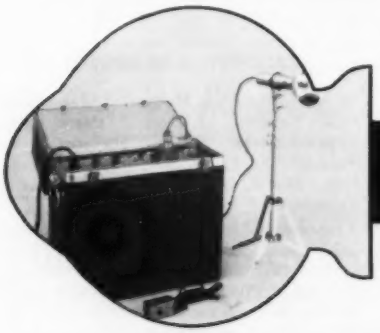

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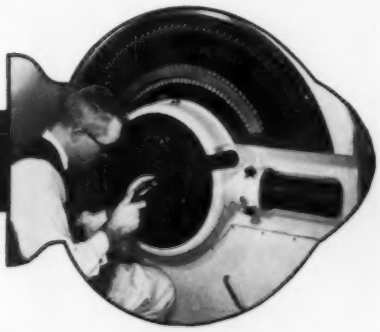

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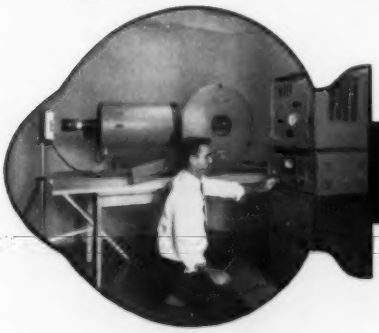

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Use of High-Speed Cinematography for the Study of Processes Occurring in an Acoustic Field in a Liquid (in Russian), L. O. Makarov, *Uspekhi Nauch. Fotografii, 6:* 211, 1959.

An abstract only is given of a lecture on results of cavitation and other process obtained by means of high-speed cinematography.—S.C.G.

Use of High-Speed Cinematography in the Study of Aerodynamic Processes and Burning (in Russian), S. V. Bukhman, *Uspekhi Nauch. Fotografii, 6:* 212, 1959.

This is an abstract of a lecture.—S.C.G.

Use of High-Speed Cinematography in Higher Schools (in Russian) B. V. Kubeev, *Uspekhi Nauch. Fotografii, 6:* 215–217, 1959.

The potentialities of high-speed films in Soviet high-school teaching are briefly reviewed. Mention is made of a number of such films which have been made and of the groups which are carrying out this type of work.—S.C.G.

A Study of the Process of Forming Metallized Coatings by the Method of High-Speed Cinematography (in Russian), S. R. Zhukovskiĭ and V. K. Pereverzev, *Uspekhi Nauch. Fotografii, 6:* 175–179, 1959.

The Soviet-made FP-22 high-speed camera has been used to study the metalization of surfaces by projecting the particles from an arc discharge between metallic wires onto a surface by means of an air blast. The disposition of the camera and optical equipment is described for the following three stages of the process: the melting of the metal; the transfer of metallic particles in the air blast; and deposition on the surface.—S.C.G.

Continuous Light Sources for High-Speed Cinematography (in Russian), V. G. Pell', *Uspekhi Nauch. Fotografii, 6:* 7–13, 1959.

High-speed cameras with frequencies up to 100,000 frames/sec may be used to photograph events lasting for 0.08 to 10 sec. Continuous light sources of high power are needed to cover this range of exposures. The requirements of a satisfactory source of this type are: high brightness and small dimensions of the light-producing body; high working stability to give even illumination; suitable spectral composition of the light; high light-output; long working life; and the possibility of being overrun for short periods of time. The high-intensity carbon arc, the high-pressure mercury-vapor lamp, the high-pressure xenon lamp and incandescent lamps for projectors and spotlights are considered from these points of view. A table shows how each type of lamp meets the requirements.—S.C.G.

Brightness of Some Flashlight Sources (in Russian), M. Vanyukov and A. A. Mak, *Uspekhi Nauch. Fotografii, 6:* 31–4, 1959.

The variation of maximum brightness with wavelength and with the induction of the discharge circuit in flashlight sources is studied.—S.C.G.

High-Power Flashlight Source. (in Russian), M. P. Vanyukov, A. F. Dobretsov, V. I. Isaenko and A. A. Mak, *Uspekhi Nauch. Fotografii, 6:* 53–57, 1959.

The lamp described is capable of giving flashes not exceeding 1 μsec in duration with a frequency of up to 4000 cps. The impulses are provided by a continuous oscillatory discharge between two condensers.—S.C.G.

Exposure Time in High-Speed Cameras with Compensating Prisms (in Russian), E. A. Tarantov and Yu. A. Tsvetaev, *Zhur. Nauch. i Priklad. Fotografii i Kinematografii, 5:* 280–288, No. 4, July-Aug. 1960.

A mathematical analysis is given of the exposure of film in a high-speed camera, using optical compensation by means of a rotating prism. The Soviet SKS-1 high-speed camera can easily be altered so that the partial exposure time (i.e., the exposure time for any individual part of the frame) can be varied without affecting the frame frequency or the total exposure time for the frame as a whole.—S.C.G.

PRINTING AND OPTICS

An Autocollimation Method of Measuring Focal Lengths of Optical Parts with Approximately Plane Surfaces (in Russian), S. E. Evlasov, *Optiko-Mekhan. Prom.*, No. 2, 37–40, 1960; *Tekh. Kino i Televideniya, 4:* 81, Sept. 1960.

An autocollimation method of measuring large focal lengths is described. This method essentially consists in determining the focal lengths of the part by means of the distance between the images of an infinitely distant object, obtained by reflection from the first and second surfaces of the part, in the image space of the objective of the viewing tube.

It is shown that, in regard to accuracy, the autocollimation method of measurement is equivalent to the method of calculation, if the surfaces are determined with an accuracy of up to 0.01 interference band.—S.C.G. (Translated from *Tekh. Kino i Televideniya.*)

The Mechanization and Automation of Motion-Picture Print Production (in Russian), V. K. Miloslavov, *Tekh. Kino i. Televideniya, 4:* 11–13, Sept. 1960.

In the Soviet Union, the printing of release positives is fairly highly mechanized, but the various auxiliary processes still require much manual work. The immediate task is, therefore, the mechanization of these processes, including the making of chemicals, testing and transport. The next stage is seen as the complete automatization of the printing process itself and, finally, the complete automatization of the whole process, making use of a combined printing and developing machine. The basic requirements are already available, but it is necessary that the printing laboratories and responsible bodies make a firm effort to solve the problems which arise.—S.C.G.

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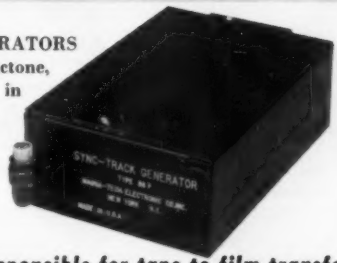

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A Sound-Absorbing Attachment for the 18- and 22-Mm. Focal-Length Objectives for the "Moscow" Motion-Picture Camera (in Russian), A. V. Zonov, *Tekh. Kino i Televideniya, 4:* 70–71, 1960.

The new 18- and 22mm focal-length lenses will not fit directly onto the "Moscow" motion-picture camera. A special holder is described for this purpose. —S.C.G.

The Measurement of the Light-Scattering Coefficient of Cinematograph Objectives (in Russian), F. S. Novik and L. M. Glotova, *Tekh. Kino i Televideniya, 4:* 48–54, Aug. 1960.

The research institute, NIKFI, has prepared an interdepartmental standard number, MN 63-59, for the measurement of the light-scattering coefficient of cinematograph objectives, and apparatus has been constructed for carrying out the tests. This consists essentially of a photometric sphere, with an aperture at one side from which light passes through the lens to be tested, and an aperature directly opposite which serves as a dark object against a bright background. Light from the lens is received by a photoelectric cell connected to a galvanometer, the lens and the cell being mounted on a rotatable arm so that the light passing through the lens can be measured at different angles. Measurements carried out on a number of lenses with this apparatus are tabulated and discussed. Generally speaking, the Soviet-produced lenses show a somewhat higher scatter than imported objectives. Possible methods of reducing the scatter are discussed. It is suggested that limits should be set to the permissible light-scatter of cinematography objectives.—S.C.G.

PROJECTION

Projection Problems in Auditoria of Wide-Screen Cinemas (in Russian), A. M. Yur'ev, *Tekh. Kino i Televideniya, 4:* 61–68, Aug. 1960.

The problems discussed include the dimensions of the auditorium, the position of the seating, the angle of viewing and projection and screen brightness, all in relation to the width of the screen.—S.C.G.

The Printing of Narrow-Gage Release Prints in Newsreel Film Studios (in Russian), I. B. Gordiĭchuk, *Tech. Kino i Televideniya, 4:* 55–60, Aug. 1960.

Consideration is given to problems arising in the organization of printing narrow-gage release prints of newsreel and documentary films in newsreel studios; a number of different working schemes are set out for printing image and soundtrack, starting with originals of 35mm film; and recommendations are given for obtaining the best quality of image and sound.—S.C.G. (Translation of Author's Abstract.)

Motion-Picture Projection Lenses (in Russian), L. N. Belyaeva, *Tekh. Kino i Televideniya, 4:* 75–78, Aug. 1960.

The structures and properties of a number of foreign (i.e., non-Soviet) projection lenses are discussed.—S.C.G.

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SENSITOMETRY AND IMAGE STRUCTURE

Domestic Considerations in Regard to Sensitometric Standardization. II (in Hungarian), T. Barna, I. Berty, G. Dobrányi, E. Schalk, and O. Szimán, *Kép-és Hang-tech., 5:* 106–107, 1959; *Referat. Zhur., Fiz.*, Abstract No. 15682, June 1960.

Observations are put forward by photographic and cinematographic technicians in Hungary in relation to the conditions of sensitometric testing and methods of expressing the properties of photographic materials. Recommendations are given on the testing of motion-picture negative and motion-picture positive materials (choice of light source and conditions for exposure to daylight and artificial light, conditions of development, method of density measurement and criteria of speed), and the evaluation of graininess, resolving power and other properties are considered.—S.C.G. (Translated from *Referat. Zhur., Fiz.*)

TELEVISION

Stereo-Color Television (in Russian), P. V. Shmakov and V. E. Dzhakoniya, *Tekh. Kino i Televideniya, 4:* 30–40, Aug. 1960.

Factors Determining the Sharpness and Detail-Rendering of Spatial Images with Different Methods of Exposing Films for Television (in Russian), V. B. Tolmachev, *Tekh. Kino i Televideniya, 4:* 21-30, Sept. 1960.

Technological factors are considered which determine the visual sharpness and detail rendering of spatial images in television presentations of films exposed by different methods. It is shown that the visual sharpness and detail-rendering of the screen image of television films is limited by the resolving power of the broadcasting video channel.—S.C.G. (Translation of Author's Abstract.)

VIDEO TAPE

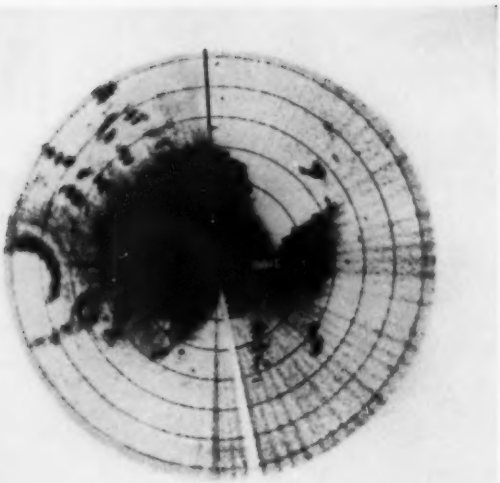
A Magnetic Image Recording Machine

A brief description is given of a prototype machine for recording pictures on magnetic tape, constructed by the Leningrad KINAP factory in collaboration with several research institutes. (S. C. G.)—R. M. Kasherininov, V. V. Radkovskii, and V. G. Komar. *Tekh. Kino i Televideniya, 4:* 57, Feb., 1960 (in Russian).

The Problem of Magnetic Tape for the Recording of Motion Pictures (in Russian) G. V. Avilov, D. M. Yuzhnaya, E. M. Boitler, and S. Kh. Nazarov, *Tekh. Kino i Televideniya, 4:* 14–20, Sept. 1960.

Magnetic tape intended for the recording of motion pictures requires properties, both mechanical and magnetic, that are different from those of ordinary magnetic tape for sound-recording. These special requirements are reviewed and the suitability of a number of existing tapes for this purpose is discussed.—S.C.G.

Filming spots on the sun



or dots on the screen

"what's" with a gun

or plots on the scene

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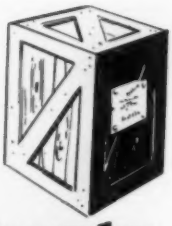

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(and developments)

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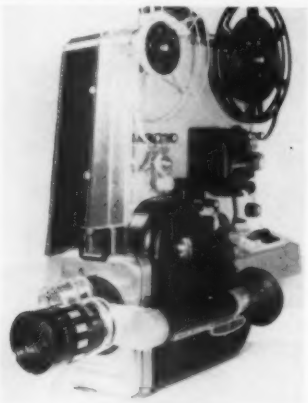
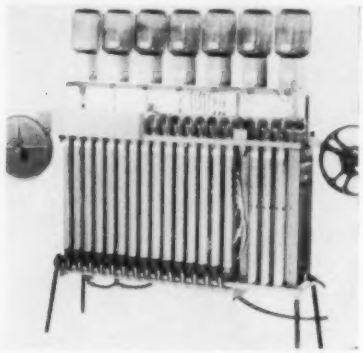
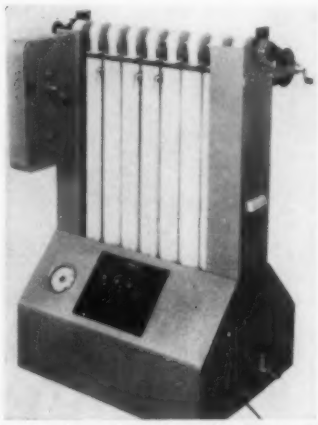


8mm magnetic sound film equipment manufactured by the Industrial Products Division of Fairchild Camera and Instrument Corp., Robbins Lane, Syosset, L.I., N.Y., has been adapted for television by Station KPHO-TV, Phoenix, Ariz., and used for news broadcasts. The equipment includes a lightweight (5-lb) camera with a built-in power supply and recording system, an 8mm projector (a specially developed version of the Cinephonic 8, built to TV projector requirements), and the Mini-Rapid 16 processor. The camera is designed to record on a 30-mil magnetic stripe which is placed on the film between the sprocket holes and the edge. A sensitive microphone permits the photographer to set the volume level according to the requirements of the situation. The amplifier and recorder will record in the ranges of 100 to 4800 cycles/sec. A 50-ft reversible film roll gives the photographer a total shooting time of approximately 5 min. In the initial newscasts, two prestriped films were used, Du Pont 931 and Eastman Kodak's Tri-X.

The film was first processed as a negative, then split to the 8mm size, spliced, and run through the adapted projector. The electrical polarity of the tube output was then reversed, giving the screen a positive image. The projector outwardly resembles the standard unit, but the inner components have been redesigned. The drive motor is a synchronous type (115-v; 1800-rpm; 1/50-hp). The standard 3-blade 55° shutter was replaced with a 5-blade 50° shutter to make the projector compatible with the scanning rate of the vidicon, synchronized with the standard 60-cycle reference. A variable intensity control was incorporated to allow changes in the projector light output. Projection is into a field lens (from a 2-in. lens) which is observed by the vidicon tube. The projector weighs 25 lb.



Automatic continuous film processors for industrial, TV news and microfilm applications are produced by Fulton Productions, Inc., P.O. Box 980, Tulare, Calif. The units are daylight operated, portable and operate from any 115-v outlet. Water and drain connections use ¾-in. garden hose. Models are available for negative, negative/positive, reversal, Ektachrome and Anscochrome, as well as microfilm emulsions. The 1200-ft daylight film magazine uses a "maze" light-trap which allows passage of staples or tape. Quick-change drive motors allow selection of film processing speeds from 2 ft/min to 16 ft/min. Prices begin at $1875 for the standard 16mm 8-ft/min B&W reversal model.



The Lawlette Daylight Film Processing Machine, manufactured by Newman & Guardia Ltd., Harlow, Essex, England, and distributed in the U.S. by Lipsner-Smith Corp., 3475 West Touhy Ave., Chicago 45, Ill., is made in four models: Model 16S — with sprocket drive for 16mm perforated film; Model 35S — with sprocket drive for 35mm perforated film or paper; Model 16F — with friction drive for 16mm nonperforated film; Model 35F — with friction drive for 35mm nonperforated film/paper.

All models are equipped with 100-ft magazines, although 400-ft magazines are available. The machine develops, fixes, washes and dries up to 400 ft of film with each charge of chemicals within commercial sensitometric limits, at speeds from 2 to

8 ft/min and up to 15 ft/min for special requirements. Measurements are 21 × 21 × 48 in. high, weight is approximately 75 lb. The path length through the machine is 50 ft.

The same company manufactures the Lawley Junior combination 16/35mm and 16mm processing machines. In these machines developer solution is recirculated at the rate of 25 g/min. Accurate gamma control can be maintained, it is said, for 6000 ft of 35mm fast panchromatic material or its equivalent, without replenishment. Output of the 16/35mm machine is up to 40 ft/min, and of the 16mm machine, up to 80 ft/min. An air knife sited after the final wash is a feature of the design as it permits the use of low-temperature drying. Drying temperature never exceeds 90 F.

These machines, as well as the smaller Lawlette models described above, are designed for rapid processing of comparatively short lengths of film and are thus particularly adapted to the processing o news film and other types of film for television. They have been in use for some time by the B.B.C. A paper describing them, by L. J. Wheeler, of the B.B.C., was presented at the 87th Convention in Los Angeles, and subsequently published as B.B.C. Engineering Division Monograph No. 30, in May 1960. Another B.B.C. Monograph, No. 33 of December 1960, refers to the Lawley machines in use at the Alexandra Palace studios in a general study of sensitometric control in film making.

Visitors to the 89th Convention in Toronto will have an opportunity of seeing the Lawlette machine on display in the Equipment Exhibit, and a brief description is scheduled for the Equipment Papers and Demonstrations Session on Wednesday afternoon, May 10.

A rental program for animation studios and equipment has been announced by Florman & Babb, Inc., 68 W. 45 St., New York 36. Completely equipped, air-conditioned animation studios in New York are available on a daily, weekly, or longer basis. Rental stands include a fully equipped 11-ft-high Portman stand (1 to 40 field), featuring a double rotary compound (used for single-movement diagonal pans) floating unit; multiplane table; automatic electric zoom focusing and other features. The Acme-Portman 16mm – 35mm rack-over camera is also available as well as less complex stands for simple animation.

A method of eliminating noise from air conditioning systems, designed by the Sound Control Department of Koppers Co., 3450 Wilshire Blvd., Los Angeles, has been installed in TV station KNXT, Hollywood. The system consists of 14 "sound traps" called Aircoustats which route the noise-ladened air through a maze of passages made of perforated galvanized steel and filled with fiber-glass matting. The matting is used to absorb the noise so that the cooled air may silently proceed to its destination. Each of the sound traps is 8 ft long. Two are installed in the main air-conditioning duct immediately where the air comes from the fan system. Nine traps are installed in individual ducts leading to recording studios and three are located in return ducts to eliminate any "backing up" of fan noise.

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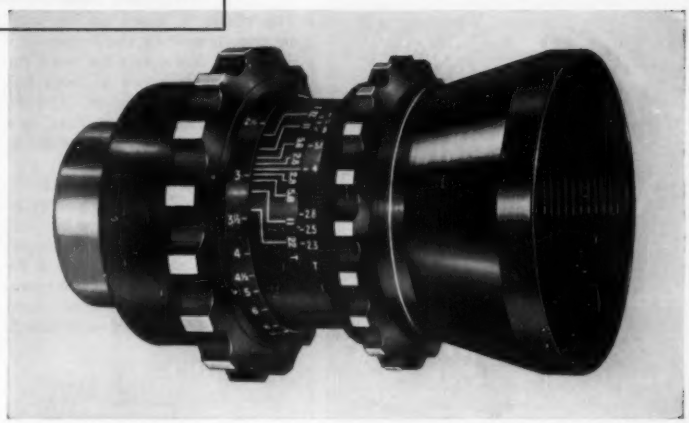

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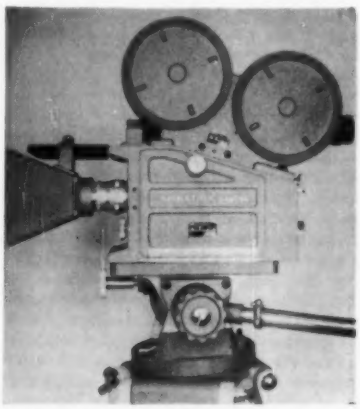
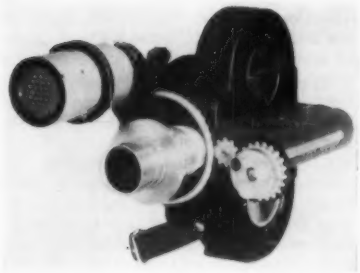
The Magnasync Series T-1000 magnetic tape recording/reproducing systems, announced by Magnasync Corp., 5546 Satsuma Ave., North Hollywood, are available with as many as 20 channels for the simultaneous recording of voice-frequency program material. The series includes a variety of tape speeds and capacities, with recording and reproducing time ranging from 8 to 24 hours. Features include plug-in transistorized circuitry; Magnasync's "synkinetic" dual-flywheel flutter-free drive; straight-line threading; differential double-capstan drive; synchronous motor to drive the tape at uniform velocity; positive, phototransistor shutoff at both ends of the reel; monitoring at high speed rewind or fast forward with special "cuing" device; provisions for remote control. The system can be packaged in a single rack cabinet or in tandem with automatic switchover to companion recorder. Optional features include a "fail-safe" sensing system which automatically starts the tandem recorder and energizes a visual and audible alarm in the event of mechanical or electronic failure; variable-speed drive; interjection of time reference signals; high-frequency erase; packaging in wall cabinet with front service access, or in a self-contained mobile trailer. The price range is from $6000 to $9000, depending on the number of channels.

Two new pushbutton zoom cameras have been added to the Director series of 8mm electric eye cameras produced by Bell & Howell, 7100 McCormick Rd., Chicago 45. Called the Zoomatic with Duo Power one of the cameras is a roll film model, designated 414P, providing a 15-ft film run for each winding, and the other is a magazine model, designated 424P, transporting 11 ft of film. The 414P is priced at $239.95 and the 424P is priced at $259.95.

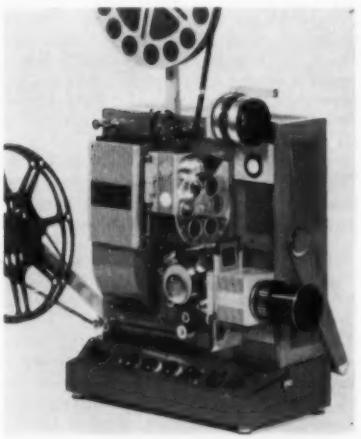


A 16mm Animation Camera based on the design of the firm's 16mm Professional Camera has been announced by Doi Kosakusho Co., Tokyo, Japan. The camera is linked to a stop-motion device. It features film movement with a registration pin to ensure steadiness of the camera image, with double or triple exposure if desired. The shutter opening, ranging from 0 to 165° can be varied while filming. According to the announcement, the prism is shifted aside by means of a knob located on the front of the camera which closes a shutter to prevent light coming back from an eye-piece, actuating simultaneously a built-in microswitch for the motor.

FS Multi-Layer, High-Efficiency Interference Films, developed by Fish-Schurman Corp., 70 Portman Rd., New Rochelle, N.Y., utilize the phenomenon of optical interference at the boundaries of materials of high and low index of refraction. Each boundary reflects radiation whose phase depends on the various thicknesses, indices of refraction and wavelength. The reflection may be made to vary with wavelength in a variety of ways. Since the multilayer system is composed of practically absorption-free, dialectric materials, the transmission for any curve may be ascertained with little or no error by subtracting the reflectance values from 100%. Glass plates or prisms are used as bases on which are deposited the different materials by evaporation under high vacuum. As many as 19 separate layers may be used to obtain a desired result. The films are available in three classifications, Selective Reflection in the Visible (400 $m\mu$ to 700 $m\mu$); Infrared; and Achromatic. Available in size 50 by 50 by 3 cm at a price of $15.00; other types and sizes are available on special order.



The Model VI-4 Autex has been added to the line of automatic photographic exposure controls for photoinstrumentation produced by Flight Research, Inc., P.O. Box 1-F, Richmond 1, Va. New features include a simpler method of matching to the iris diaphragm of any lens; internal limit switches; removable photocell for remote locations; and simplified construction and mounting. The device, normally used for motion-picture work, is designed to be mounted on any camera and to drive the iris ring of the lens. A simple Index Dial adjusts the control for all film speeds, frame rates and shutter openings. A Lens Dial, which is set only once for any given lens, adapts the control electronically to the lens. The high-speed mechanism responds to changes in light level as fast as seven stops per second. The transistor circuit is mounted in a control box of less than 0.04 cu ft.



A 16mm sound projector called the Vario-projector, reported in a recent issue of the *Hungarian Exporter*, was developed by Gyula Urban, a young Hungarian scientist. Features of the projector include the Anamorphot, a large-screen optical adapter, normally changeable in a casing moving on a slide, with spring case-binding pin; the bioptiksystem, a double-lens casing moving on a slide way, with position fixer, for the protection of slides and films; the Variodia, a slide projecting adapter to be fitted to the optical lens of the sound film projector; the Variomikro Adapter, a micro-projection accessory for the projection of microscopic slides; and the Variophon, a combined optical and sound adapter.

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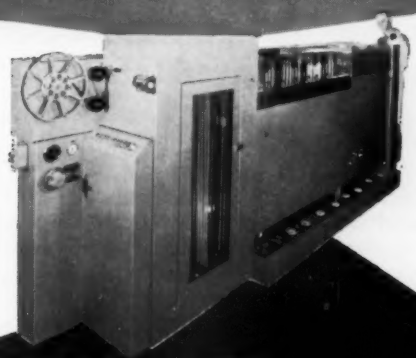

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The Gossen-Lunasix Electronic Exposure has been designed to achieve a high degree of sensitivity by means of a specially developed photoconductive element incorporated into a sophisticated circuit and powered by a minute ($\frac{1}{4}$ by $\frac{3}{4}$-in.) long-life mercury cell. Produced by the Gossen Electrical Instrument Co. of Germany and introduced in the United States by Kling Photo Corp., 257 Park Avenue South, New York, the meter is said to approximate the human eye in its spectral response, and to be able to indicate exposure at extremely low light levels. The meter weighs 7 oz and measures $2\frac{3}{4}$ by $3\frac{3}{4}$ by $1\frac{1}{4}$ in.

The 764W Tele-Sonic Wireless Remote Slide Projector introduced by Bell & Howell, 7100 McCormick Rd., Chicago, 45, uses ultrasonic sound waves to focus and change slides. The remote control has two miniature transmitters which vibrate and create sound waves in the same way as a tuning fork. The sound waves created by the transmitters are ultrasonic waves capable of operating the projector but too high to be heard by the human ear. One transmitter sends high-frequency waves at 36,500 cycles/sec for focusing; the other sends high-frequncy waves at 40,000 cycles/sec to change or advance slides. The transmitters are operated by two buttons on the remote control. An ultrasonic receiving unit in front of the projector picks up the inaudible sound waves and triggers the focusing and slide advance mechanisms. The projector is priced at approximately $269.95.

The Simoramic Spectrum Analyzer Model 4A has been announced by Federal Scientific Corp., 615 W. 131 St., New York 27. Operating in real time, the instrument is designed for simultaneous analysis over the frequency range of 1 to 200 cycles/sec without the use of contiguous filters. It has a 3-db resolution of 1.3 cycles/sec and its 40-db bandwidth is 12 cycles/sec. The instrument is a delay-line synthesized Fourier analyzer operating at theoretically maximum information extraction rate.

Multiple Octave Band Filters, Models 358 (8-octave) and 359 (9-octave) have been announced by Allison Laboratories, Inc., 11301 East Ocean Ave., La Habra, Calif. The band filters are paralleled with individual rms meters on the output of each band. The meters have a 16-db range. A 30-db attenuator for each meter gives a measuring range of 46 db. Separate output acks for each band have a dynamic range of 76 db. The filters are passive networks said to have very low noise level and good response to transient peaks. Attenuation outside the passband is at the rate of 40 db per octave. Model 358 is priced at $2635 and Model 359 is priced at $2990.

A limited number of 8mm resolution targets for camera and projector lens tests and evaluation, originally manufactured for the firm's own use, are now available from Wollensak Optical Co., 850 Hudson Ave., Rochester 21, N.Y. Queries should be addressed to David C. Gilkeson, Chairman, Engineering and Product Development. The targets are on $\frac{1}{16}$-in. by $\frac{1}{16}$-in. glass plates. The patterns are located in center, corners, sides and top and bottom of the 0.125-in. by 0.1875-in. area. Each

pattern is comprised of 20, 30, 40, 50, 60, 80, 90, 100 and 110 lines/mm targets. The targets are priced at $50.

A test instrument for determining VSWR and attenuation values of r-f components or circuits has been announced by Telonics Industries, Inc., Beech Grove, Ind. The test set uses a pair of coaxial switches operating at 30 cycles/sec to produce a dual oscilloscope trace. The two traces, representing a reference value and an unknown provide instantaneous readings of VSWR or attenuation for the device under test. The test set, called Model SP160, operates over a frequency range of 200 to 475 mc, and uses a Telonic SD-2M Sweep Generator to provide the swept signal. A comparator module, equipped with input terminals and two r-f attenuators, is incorporated with the sweep generator to complete the test set. The instruments are supplied for various applications and prices range from $1600 to $1800.

A turret attenuator unit covering the 0–59 db range in 1-db steps has been announced by Telonic Industries, Inc., Beech Grove, Ind. The device, called the TAB-50, is designed for use in the d-c to 1250-mc frequency range. The firm has also announced a Decade attenuator, the model TAD-50, designed for r-f signals in the d-c to 1250-mc range. The unit contains three separate turret attenuators, two covering a 0–50-db range in 10-db steps, and the third turret covers a 0–10-db range in 1-db increments. Internally connected in series, the three provide a total of 110-db attenuation, adjustable in 1-db steps. It is priced at $325. Also available is a coaxial switch for use with r-f circuits over a wide frequency range. Called the TS-1, it is a double-pole, double-throw unit covering frequencies from d-c to 1000 mc, and said to be useful to 1500 mc. It is priced at $45.

A digital computer system called TASCON (Television Automatic Sequence Control), designed especially for automatic switching in broadcasting stations, has been developed by TRW Computers Co., Division of Thompson Ramo Wooldridge Inc., 202 North Canon Dr., Beverly Hills, Calif. The new system can store switching orders for the entire program day in the computer memory, including orders for equipment warm-up or prestart. The system also permits changes to be entered at any time. This flexibility is possible because the operator can communicate directly with the digital computer, which is designed for quick access to the information stored in its magnetic-drum memory. The circuits that activate the programming controls are compatible with any of the voltage levels used in the switching circuits of TV stations. Although the primary function of the system is automatic switching control, it can also be used as an aid to program scheduling and operations, for maintenance checkout of video and audio systems and for record keeping to simplify accounting. The system employs solid-state components, modular construction, plug-in circuit cards and mercury-wetted contact relays. It uses many of the circuits and components of the RW-300 Digital Control Computer, developed early in 1959 to control petroleum and chemical processing units. (See the first paper in this issue of the *Journal*.)

A TV "studio on wheels" has been equipped by Radio Corp. of America for Video Tape Unlimited, Inc., 144 E. 57 St., New York. The bus is 40 ft long and has a control room capable of seating nine persons. Technical equipment includes four RCA image-orthicon TV tape recorders, special-effects system, a generator, audio tape facilities, record turntable and other broadcast equipment. The bus also contains its own lighting equipment and reflectors for night use. Camera platforms are attached near the front and rear bumpers. Cameras used at one location can be kept in place on these platforms while the bus moves to a new location. All four cameras can be attached to the roof of the bus, or two placed on the roof, and one on each platform, with filming continuing at bus speeds up to 70 mph.

An experimental system for transmitting video information via modulated ultraviolet has been developed as part of a program of research in ultraviolet space communications conducted by Westinghouse Electric Corp., Box 2278, Pittsburgh 30, Pa. The system employs a standard Westinghouse 5ZP16 cathode-ray tube as both a source and a modulator of ultraviolet. A conventional ultraviolet-sensitive photomultiplier is used to receive the transmission. Input signals are supplied to the system by a standard television camera and the output image is displayed on the screen of a standard TV receiver. During a series of experiments, the short-persistence phosphors of the 5ZP16 tube produced a radiated output of one watt of ultraviolet from a 0.011-in. spot when bombarded by a 30-kw, 0.335-ma electron beam. Focused into a 0.033-degree conical beam by a one-meter optical reflector of 19-in. focal length, the power density of 10.3 kw/sq in. was found to be sufficiently intense to permit communication over a 10-cycle band at distance of about 15 million miles. At ranges in the order of lunar distance, it would be sufficient for the transmission of video information.

Adler Translators, automatic receiver-transmitters designed to bring TV reception to unserved areas, are produced by Adler Electronics, Inc., One LeFevre Lane, New Rochelle, N.Y. The translators also are used for production-line testing of UHF TV receivers. Signals from the translators, which convert off-air VHF TV programs to UHF channels, are fed to test positions via coaxial cable. Power-splitting devices permit the 10-w output of each translator to cover the required number of alignment and sensitivity test positions.

An x-ray system, called the Televex, developed by Westinghouse Electric Corp., 2519 Wilkins Ave., Baltimore 3, Md., is used for diagnosis and study of patients. Radiation passing through the patient is picked up directly by an image amplifier, without any involvement of a fluoroscopic screen. Intensified about 1500 times, the image is transmitted by an optical system to a television camera and then to one or more monitor units. Simultaneously the motion

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study can be transferred to tape for repeated viewing or transferred to film for permanent record. A separate operating feature is the ability to magnify images electronically for close-up viewing.

The addition of nickel-cadmium batteries to its line of industrial storage batteries has been announced by the Exide Industrial Division, Electric Storage Battery Co., Rising Sun and Adams Ave., Philadelphia 20. This type of battery, which has nickel and cadmium oxide active materials contained in perforated steel pockets of the positive and negative plates, is used in special applications including emergency lighting systems, switchgear tripping in electric utility substations, and for stand-by use to assure continuous operation of microwave systems.

employment service

These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Engineer-Administrator. Have designed, set up and managed motion-picture laboratories in color and black-and-white. Familiar with full range of operations and equipment in a laboratory. Graduate M.I.T.: M.S. in Chemical Engineering, B.S. in Business and Engineering Administration. Several languages. Desire challenging position. Apt. 2J, 130 Orient Way, Rutherford, N.J. WEbster 3-3238.

Representative. Graduate student working towards doctorate in Educational Television, receiving M.A. in motion pictures June 1961, B.A. in theater television, will be touring Latin America covering 64 cities in 20 countries and contacting over 100 television stations and 200 producers of newsreel, documentary, educational, television and feature films. Tour will be repeated each summer for three years. Also background three yrs electrical engineering and four yrs sales. Will represent your company and translate brochures into Spanish or Portuguese. Don Stewart, 2005 Sixth St., Santa Monica, Calif. EX 9-6795

Film Production Administrator. 24 yrs experience in industrial motion-picture and general photography production. Technical background in most crafts; writer and director-cameraman. Until recently vice-president in charge of sales for production company in New York; familiar with government contracts and security problems. Currently free lancing but wish to settle down again; will relocate. Dermid Maclean, 8 Cameron Rd., Tenafly, N.J.

Cameraman-Director, 40, Class "A" IATSE New York, seeks interesting, challenging assignment or top position. 19 yrs production work in studio and on locations all over Europe, Asia and Africa. Producer for U.S. Government; experienced in studio and production center organization, training of technical staff, supervision of film editing and completion. Technical consultant, familiar with most U.S. and foreign equipment. Fluent German, French, some others. Writing credits; internatl. film award. Prefer educational and documentary field, also highly technical training and industrial films. Shooting all types of productions; flawless and imaginative coverage on any subject, anywhere. Permanent relocation possible. Cinematographer, 92 Park Hill, Massapequa, L.I., N.Y. LI 1-9487.

Cameraman-Editor. Since 1935 active in production of documentaries, television commercials, educational, industrial and progress report films, can handle both 35mm and 16mm black-and-white as well as color. Wants steady work or assignments, anywhere. Can edit A and B rolls, and write own scripts. Modest fee. Will send resume on request. Henrick N. Weener, 1215 Cabrillo Ave., Venice, Calif. EX 9-5692.

Positions Available

Equipment Maintenance Men. Experienced in service and repair of one or more of the following types of equipment: Moviolas, sound projectors, Mitchell, Bell & Howell and Arriflex cameras, lens testing and calibration, audio and electronics for magnetic recorders and amplifiers, lighting and electrical equipment, machine shop. Write fully—experience and salary required. A. Florman, Florman & Babb, 68 West 45 St., New York 36.

Film Production Aide. The New York State Department of Civil Service will conduct an examination for Film Production Aide on April 29, 1961. Salary $3500 to $4350 in five annual increases. Open only to New York State residents. A Film Production Aide assists in preparations for shooting of motion picture film. Requires one year of paid experience in motion picture or television work and either one year of experience in operation of motion picture projector or one year of training in photography or television production or equivalent training and experience. For details contact the Recruitment Unit, Box 84-A, New York State Department of Civil Service, The State Campus, Albany 1, N.Y.

Soundman. Motion-picture recording studio requires alert soundman for staff. Must know all phases of sound recording including RCA equipment. Send resume to 446 East 86 St., Att: Monahan, Rm. 6-C, New York 27.

Film Processor. Motion-picture recording studio requires man for developing film in laboratory. Experience. Permanent. Write particulars to Mrs. M. Monahan, 446 East 86 St., Rm 6-C, New York 28.

Motion Picture Sound Engineer. Experienced in recording motion picture soundtracks, transferring and mixing. Familiar with design and circuits of professional equipment. Desire to work for religious film unit. Write for application to TRAFCO of The Methodist Church, c/o Duane Muir, 1525 McGavock St., Nashville 3, Tenn.

Closed-Circuit TV Technician or Engineer. Experienced. Must be familiar with all phases of closed-circuit television systems. To work with Chief Engineer of West's largest producer of CCTV equipment. L. G. Schlicht, 1920 So. Figueroa St., Los Angeles 7, Calif. Richmond 8-2852.

Résumés / Resumenes / Zusammenfassungen

Ordinateur pour le contrôle de la commutation automatique de télévision

A. B. ETTLINGER [145]

Le premier système employant un ordinateur pour le contrôle de la commutation automatique en télévision a été développé sous les auspices de CBS et le 31 décembre 1960 était mis en opération. Ce système représente une avance considérable sur les techniques utilisées auparavant à l'égard de la capacité quantitative de fonctions possibles, de la facilité de réviser l'horaire des programmes et de l'adaptabilité aux changements des façons d'opération. En satisfaisant ces exigences strictes, l'utilisation d'un ordinateur bien qu'en offrant suppléments extraordinaires, qui n'auraient pû être achevés par d'autre moyen qu'à un prix exhorbitant, est économique. Cet article décrit les considérations théoriques en rapport de cette application. (*Tr. par George Benkowsky*)

Appareillage automatique pour commande de commutation de poste de télédiffusion

F. CECIL GRACE et CHARLES E. SPICER [150]

On a conçu un appareillage de sélectionnement pour régies centrales de postes de télédiffusion, dans lequel les évènements sont emmagasinés dans des éléments de mèmoire à tubes trochotrons, avec la durée de temps que chaque évènement doit rester en ondes. Sitôt qu'un évènement est selectionné, le temps associé se met à décompter 10-9-8-7, etc. jusqu'à zéro. Quand il atteint zéro, l'évènement suivant se met automatiquement en onde, et le temps associé commence son décomptage. En cas que l'opérateur se décide de trancher un évènement net, avant la fin du temps prévu, et de le remplacer par l'évènement successif, il n'a qu'à toucher un bouton sur le panneau de commande. De même façon, s'il veut prolonguer un évènement, il y a un autre bouton qui arrête le décomptage. En ce cas, l'évènement reste en onde jusqu'à ce que l'opérateur touche le bouton susmentionné. Donc, on obtient un chronométrage précis automatique, mais en gardant toujours le pouvoir d'intervenir. (*Tr. par F. Cecil Grace*)

Convertisseur de normes pour échanges de télévision entre l'Europe et l'Amérique du Nord

A. V. LORD [156]

Lorsque l'enregistrement des signaux de télévision sur bande magnétique de 5 cm a été généralement adopté par les organismes de radiodiffusion des deux côtés de l'Atlantique, on s'est aperçu qu'il s'agissait là d'un progrès important en matière d'échanges de programmes. Toutefois, l'enregistrement magnétique consiste en une mise en mémoire de la forme d'onde du signal video et non de l'image elle-même (comme c'est le cas dans l'enregistrement sur film), ce qui pose un nouveau problème. Etant donné les différences qui existent entre les normes de télévision, il est nécessaire de disposer d'une méthode de conversion des signaux d'une norme à une autre.

Une solution satisfaisante du problème existe depuis plusieurs années en Europe, où l'on utilise trois normes d'analyse des images (819, 625 et 405 lignes). Le procédé de conversion est cependant relativement simple du fait que la fréquence de trame est toujours égale à 50 Hz. Les articles 1-3 décrivent le problème de la conversion et l'équipement correspondant.

De nouvelles recherches ont récemment conduit à la mise au point d'un convertisseur adapté au cas où les fréquences de trame sont respectivement égales à 50 Hz et à 60 Hz.

Films Singuliers: Groupe cinématographique dont le but est l'instruction et la production de films à l'Université de Bob Jones

KATHERINE STENHOLM [160]

Le groupe produit et distribue des films dramatiques de 16 m/m, quelques-uns en durée de deux heures, sur les thèmes religieux et éducationnels; des travelogues, des documentaires et de courts sujets promotionnels. Des cours compréhensifs menant aux degrés B.A. et M.A. sont offerts. L'atelier et l'équipement sont d'une étendue peut-être unique parmi les institutions de l'éducation supérieure. "Les Films Singuliers" fournit le "Laboratoire" pour l'expérience pratique en toutes les phases de cinéma pour les étudiants dans la Division de Cinéma de l'École des Beaux-Arts de l'Université de Bob Jones. (*Tr. par Robert Besancon*)

Studio cinématographique de L'Université de Brigham Young

ROBERT W. STUM et R. IRWIN GOODMAN [165]

Après avoir dressé des plans et fait des recherches pendant cinq ans, le nouveau studio de cinéma du Département de Production Cinématographique de l'Université de Brigham Young a commencé à opérer au cours de l'automne 1958. Avec le but de produire des films de la plus haute qualité, à un prix raisonnable, pour l'Université et l'Eglise de Jésus Christ des Derniers Jours (Mormons), le studio a été construit pour porter l'idée d'un scénario sur l'écran. La partie principale de ce nouveau studio est une scène montée au point de vue acoustique de 80 par 100 pieds (24,38m. × 30,38 mètres). Il y a assez d'espace pour toutes les activités touchant à la production cinématographique telles que l'animation, le département de l'art, l'assemblage de construction, l'entrepôt d'emmagasinage, l'enregistrement du son et le doublage pour les films en langues étrangères. On y trouve aussi des bureaux séparés pour le personnel de la production et les scénaristes. Le matériel moderne a été choisi de façon qu'il soit approprié aux niveaux les plus hauts de la perfection. (*Tr. par Jean-Pierre Heudier*)

Paramètres physiques et techniques de tubes-éclair

I. S. MARSHAK et L. I. SHCHOUKIN [169]

On a effectué des études portant sur des tubes-éclair à colonne de décharge limitée (tubes capillaires) et d'autres à décharge illimitée (lampes à ampoules sphériques) dans un circuit à inductance minimum. Ces études ont compris

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des cas extrêmes des paramètres de construction et d'alimentation. Les caractéristiques de décharge des tubes capillaires sont analogues à celles des tubes de grand diamètre, bien que les valeurs correspondantes de la résistance spécifique se produisent à des champs électriques environ 5 ou 10 fois plus élevés.

La résistance spécifique du plasma devient quasi-constante (égalant $\sim$ 0,02 ohm/cm) à $E \gtrsim 120$ v/cm. Le voltage d'extinction de la décharge est approximativement inversement proportionnel au diamètre intérieur du tube. L'accroissement du rendement lumineux s'arrête à $E \cong 400$ v/cm (atteignant des valeurs très élevées d'environ 40 lm/w). On a déterminé la relation entre la durée de l'éclair τ et les caractéristiques de construction, et entre cette durée et les paramètres d'alimentation, pour une grande variété de conditions. Dans des limites étroites de modifications des paramètres, on peut employer l'expression suivante:

$$\tau = AU_0^{-0.6}\,(C\,l)^p d^{-q}$$

Ici A est le coefficient de proportionnalité, U_0 est le voltage initial au condensateur d'alimentation, C est la capacité du condensateur, l et d sont respectivement la longueur et le diamètre intérieur du tube, et p et q sont des exposants approximativement constants, qui changent respectivement de 0,5 à 1 et de 0,5 à 2, pour une ample variation des paramètres. L'influence de l'inductance inhérente du circuit de décharge sur les caractéristiques lumineuses des lampes tubulaires est quasi-insignifiante. Les températures d'emploi des lampes tubulaires en *quartz* et en *verre*, qui sont affectées à un service stroboscopique de longue durée (750 C et 250 C respectivement) sont atteintes à des puissances moyennes d'environ 10 et 1,8 w/cm de longueur de tube respectivement. Les tubes fonctionnent pendant quelques secondes (sans refroidissement forcé) à des puissances respectives de 40 et 4 w/cm.

Le facteur de charge, $(CU^4)_{max.}$, qui détermine les limites de charge dans des conditions de fonctionnement à éclair unique, ne dépend pas du diamètre d pour les tubes en *verre* dans l'intervalle de 0,5 à 11 mm, et pour les tubes en *quartz* dans l'intervalle de 0,5 à 2 mm. Le temps nécessaire pour la désionisation de l'espace gazeux dans les tubes capillaires en quartz, qui dissipe environ 2 w/cm, augmente de 80 à 270 μsec pour un accroissement du champ électrique initial de 140 à 280 v/cm. Aux puissances élevées, la période de désionisation diminue de 500 à 300 μsec. Par suite, les fréquences critiques d'éclair de ces tubes (sans aucun élément supplémentaire de commutation dans le circuit de décharge) sont égales à 12 kc/sec aux faibles wattages et sont d'environ 3 kc/sec aux wattages plus élevés.

Afin d'étudier les rendements extrêmes de décharge des tubes à ampoules sphériques, on a essayé divers types de condensateurs à faible inductance et de constructions de tubes. Parmi ces types figuraient des condensateurs céramiques discoïdes, cylindriques et en forme de marmite, des condensateurs en quartz de forme cylindrique et sphérique, des condensateurs à film de forme cylindrique, ainsi que des amenées de courant, des connexions et des électrodes de type discoïde et coaxial. On a pu ainsi obtenir des renseignements pour les circuits de décharge de la plus faible inductance possible. Les études ont porté en particulier sur les vitesses de détente de la colonne de décharge et sur les caractéristiques de décharge pour divers paramètres d'alimentation. On a établi notamment les données constructives et les paramètres d'alimentation pour les tubes d'une durée d'éclair de 0,1 μsec, d'une fréquence d'éclair de 3 kc/sec et d'une puissance de 1 kw.

Des sources de flash de l'ordre des submicrosecondes

HAROLD E. EDGERTON, JOHN TREDWELL et KENNETH W. COOPER, JR. [177]

Les auteurs donnent les détails de construction de deux sources de flash de l'ordre des submicrosecondes pour la photographie par les techniques à lumière réfléchie, sciographie et schlieren. La source destinée à la photographie avec lumière réfléchie utilise une aéro-étincelle "guidée" produite à 18 kv avec 0,05 μf pour donner un éclair de $\frac{1}{4}$ de μsec d'une intensité lumineuse maximum de 5 millions de bougies. On donne une description du tube-éclair de construction spéciale, ainsi que de son système d'alimentation électrique et son circuit de déclenchement. Ce circuit déclencheur peut être commandé par microphone, phototube, contacteur ou un autre signal électrique, et comporte un retard réglable. Des photographies prises avec l'appareil sont représentées.

L'article décrit aussi une petite source d'étincelles capable de produire des flashes d'une durée d'environ 10 millimicrosecondes pour la sciographie et la photographie schlieren. Les valeurs relatives de la luminosité maximum et de la durée du flash sont indiquées en fonction de la pression pour l'air, l'azote, l'oxygène, l'anhydride carbonique, l'hydrogène et l'argon. La résistance de la distance explosive est donnée en fonction de l'écartement pour l'air.

La camera à fente $f/10$ améliorée: un modèle versatile pour la recherche sur les explosions

BERLYN BRIXNER [180]

La camera à fente $f/10$ que nous avons décrite dans un autre article, a été équippée avec une succession d'accessoires raffinés qui permettent de l'adapter à une grande diversité de problèmes de recherche sur les explosions. Pour que la caméra soit employable avec un assortiment de lentilles, elle a été outillée avec les accessoires réglables suivants: des montures de caméra et de lentille, des lentilles démontables, une commande à distance de la mise au point, une monture de la fente, une monture de la lentille du champ, et un viseur. Les accessoires qui aident à obtenir l'ajustement relatif exact entre l'objet et l'image finale sont un projecteur pour illuminer la fente, une monture de précision pour la lentille qui corrige l'astigmatisme, et un appareil à examiner l'image de la fente balayante. Et pour protéger le personnel en cas d'une explosion du miroir pendant que la caméra travaille, on a installé une armature protectrice.

Calculadoras digitales para el mando de interruptores automáticos de televisión

A. B. ETTLINGER [145]

La CBS desarolló et primer sistema de emplear una calculadora digital para el mando de los interruptores automáticos usados en el campo de televisión y lo puso en operación el 31 de diciembre 1960. Este sistema ofrece un adelanto verdadero sobre metodos anteriores con respecto a capacidad de funciones, facilidad de cambiar el horario de programas, y adaptabilidad a cambios en métodos de operación. En satisfacer éstos requisitos estrictos, el uso de una calculadora se prueba ser razonable económicamente ofreciendo ventajas afuera del alcance de otros métodos, excepto a un costo prohibitivo. Este papel describe las consideraciones teoréticas en cuanto a ésta aplicación. (*Tr. de E. J. Moulton*)

Aparato automático para comandar las comunicaciones del puesto de televisión

F. CECIL GRACE y CHARLES E. SPICER

[150]

Se ha estado diseñado un aparato de selección para reglas centrales de los puestos de televisión, en lo cual los eventos estan atesorado en los elementos de memoria a tubos trocotrones, con duración del tiempo que cada evento debe quedar en las ondas. Tan pronto como cada evento está elegido, el tiempo asiciado empieza el contaje, 10-9-8-7, etc., hasta zero. Cuando el llegue a zero, el evento próximo se pone automaticamente en la onda, y el tiempo asociado comenza su contaje.

Si acaso el operario decide hacer cesar un evento antes del fin del tiempo asignado y le reemplazar con el evento sucesivo, él tiene solamente necesidad de tocar un botón del entrepaño de comandar.

En el mismo modo, si él quiere prolongar un evento, hay otro botón lo cual suspende el contaje. En este caso, el evento queda en la onda hasta que el operario toca el botón ya mensionado. De consiguiente se obtiene una cronometria precisa automatica, pero el poder de interponerse está siempre preservado.

Un convertidor de modelo para unos cambios de televisión entre la Europa y America del Norte

A. V. LORD [156]

Cuando el registro de las señales de televisión en cinta magnetica de 5 cm ha estado generalmente adoptado para las organizaciones de radiodefusión de ambos lados del Atlántico, se ha percibido que este hacía un progreso importante en modos de cambios de programas. En todo caso, el registro magnetico consiste en poner en memoria en la forma de una onda de señal vidio y no la imagen misma (por lo que está el caso en el registro en película), lo cual pone un problema nuevo. Estando dado las diferencias que existe entre los modelos de televisión, necesita disponer de un moda de conversión de las señales de un modelo a otro.

Hay algunos años que una solución satisfactoria del problema existe en la Europa, a donde se utiliza tres modos para analizar las imagenes (819, 625 y 405 lineas). A lo menos, el procedimiento de conversión está relativamente simple a hacer porque la frecuencia de trama está siempre igual a 50 c/s. Los articulos [1], [2], y [3] describen el problema de conversión y el aparato correspondiente. Las investigaciones nuevas han recietemente conducido al desarrollo de un convertidor adaptado a los casos en donde las frecuencias de trama estan respectivamente igual a 50 c/s y a 60 c/s.

Películas Inusuales: El Departamento de Producción e Instrucción de las Películas Cinematográficas de la Universidad de Bob Jones

KATHERINE STENHOLM [160]

El Departamento produce y distribuye las películas dramáticas cinematográficas de largo metraje de 16 milímetros acerca de temas religiosos y educacionales, conferencias sobre viajes, temas documentales, y tópicos cortos para promoción. Se ofrecen cursos comprensivos necesarios para los títulos de bachillerato y grado de maestro en Cinema. Las facilidades del estudio y el equipo son de escala, quizás, únicas entre las instituciones de enseñanza superior. Películas Inusuales provee el " laboratorio" para experiencia práctica en todas las fases de cinematografía para los estudiantes en la División de Cinema de la Facultad de Bellas Artes de la Universidad de Bob Jones. (*Tr. de Barbara Stokely*)

Ele studio cinematografico de la Universidad de Brigham Young

ROBERT W. STUM y R. IRWIN GOODMAN

[165]

Despues de cinco años de estudiar y planear el nuevo estudio cinematógrafo para el Departamento de Cinematografía de la Universidad de Brigham Young empezo operaciones en el otoño de 1958 con el objeto de producir películas de la más alta calidad a costos resonables para la Universidad de la Iglesia de Jesucristo de los Santos de los ultimos dias (Mormones), el estudio fue designado para transportar una idea desde el manuscrito a la pantalla. La unidad basica de

este nuevo facilidad es un escenário de 80 por 100 pies. Adequado espacio es provunido para todas las actividades relacionados con la produccion cinematografica tal como animación, departamento de arte, construcciones decorativas, grabación de sonido, sincronación de sonido donde se puede cambiar de la lengua original a otras. Incluso hay officinas separadas para los escritores y para el personal de producción. Equipo moderno fue seleccionado para adaptación y para alcanzar las normas más altas de perfección. (*Tr. de B. F. de Hoyos*)

Parámetros fisicos y técnicos de tubos instantaneos

I. S. Marshak y L. I. Shchoukin [169]

Se han hecho estudios de tubos instantaneos con una columna de descarga limitada (tubos capilares), y con una descarga ilimitada (lámparas con ampolla esférica), en un circuito de inductancia mínima. Las investigaciones comprendieron casos extremos de los parámetros de construcción y de alimentación. Las caracteristicas de descarga en capilares son similares a las de tubos de diámetro amplio, aunque los valores de resistencia específica correspondiente a las partículas se manifiestan con campos eléctricos 5 o 10 veces mayores. La resistencia específica del plasma llega a ser casi constante (llegando a $\sim$ 0,02 ohmios/cm) a $E \gtrsim 120$ v/cm. El voltaje de descarga de extinción es inversamente proporcional al diámetro interno del tubo, aproximadamente. El aumento de eficiencia luminosa termina a $E \simeq 400$ v/cm (alcanzando valores muy altos de alrededor de 40 lm/vatio). Se determinó la dependencia de la duración del destello τ respecto de los datos de construcción y de los parámetros de alimentación, en muy variadas condiciones. Dentro de límites muy estrechos de modificaciones se pueden emplear las siguientes expresiones:

$$\tau = AU_0^{-0.6}(Cl)^p d^{-q}$$

donde, A es el coeficiente de proporcionalidad; U_0, el voltaje inicial del condensador de alimentación; C, la capacidad del condensador; l y d, la longitud y el diámetro interior del tubo; p y q, son exponentes aproximadamente constantes, que varian respectivamente de 0,5 a 1 y de 0,5 a 2, para amplias variaciones de los parámetros. La influencia de la inductancia del circuito de descarga inherente sobre la característica luminosa de lámparas tubulares es casi insignificante. La temperatura de trabajo de las lámparas tubulares de *cuarzo* y de *vidrio* que están en operación estroboscópica de larga duración (750 C y 250 C respectivamente) se obtiene a potencias promedias de alrededor de 10 y 1,8 vatios por cm. de longitud de tubo, respectivamente. Los tubos funcionan por unos segundos (sin enfriamiento forzado) a potencias de 40 y 4 vatios por cm., respectivamente. El factor de carga, $(CU^2)_{max.}$, que determina los límites de carga en condiciones de operación de un solo destello, no depende del diámetro d en los tubos de *vidrio* de 0.5 a 2 mm. El tiempo necesario para la desionización del espacio de gas en tubos capilares de *cuarzo*, con disipación de $\sim$2 vatios por cm., aumenta de 80 a 270 μseg. para un aumento del campo eléctrico inicial de 140 a 280 voltios por cm. A alta potencia el periodo de desionización baja de 500 a 300 μseg. Por lo tanto, las frecuencias críticas de destello de tales tubos (sin ningún elemento conmutativo adicional en el circuito de descarga) son de 12 kc/seg. a baja potencia (vatios) y de alrededor de 3 kc/seg. a potencias más altas. Para estudiar condiciones de descarga extremas en tubos con ampolla esférica, se probaron varios diseños de tubos y de condensadores de baja inductancia. Estos fueron los condensadores de cerámica en forma de disco, de olla y cilíndricos; los condensadores de cuarzo cilíndricos y esféricos; los condensadores peliculares cilíndricos; los conductores de entrada discoidales y coaxiales, las conexiones y los electrodos. Como resultado se obtuvieron datos para circuitos de descarga de la mínima inductancia posible. Se hicieron investigaciones de las velocidades de expansión de la columna de descarga y de las características de descarga para varios parámetros de alimentación. Se establecieron los datos de construcción y los parámetros de alimentación para tubos de 0,1 μseg. de duración de destello, 3 kc/seg. de frecuencia y una potencia de 1 kilovatio.

Fuentes de flash del orden de submicrosegundos

Harold E. Edgerton, John Tredwell y Kenneth W. Cooper, Jr. [177]

Se dan los detalles para el diseño de dos fuentes de flash del órden de submicrosegundos para fotografía por las técnicas de luz reflejada, las de silueta y las estrioscópicas. La fuente para fotografía de luz reflejada tiene una chispa-de-aire "guiada" que se produce con 18 kv. y 0,05 μf, y que da un destello de 0,4 μseg., de una intensidad luminosa de 5 millones de bujías. Se describe el tubo fluorescente de diseño especial junto con su sistema de alimentación de energía eléctrica y su circuito disparador. Este circuito disparador puede regularse mediante un micrófono, una célula fotoeléctrica, un contactor u otra señal eléctrica, y lleva un retardador ajustable. Se muestra una fotografía tomada con el dispositivo.

También se describe una pequeña fuente de chispa que puede producir destellos de alrededor de 10 mμseg. de duración para fotografía de silueta y de técnica estrioscópica. Se da la luminosidad máxima y la duración de destello relativas, en función de la presión para el aire, el nitrógeno, el oxígeno, el anhídrido carbónico, el hidrógeno y el argon. La resistencia del intervalo se da en función de la longitud del intervalo para el aire.

La cámara mejorada de imagen panorámica f/10: un modelo versátil para investigación de explosivos

Berlyn Brixner [180]

La cámara de imagen panorámica f/10 descrita previamente ha sido dotada de una serie de refinados accesorios para poderla usar en una amplia variedad de problemas en la investigación de explosivos. Para que la cámara pueda usarse con un juego de lentes objetivos se la ha dotado de los siguientes accesorios ajustables: montajes para la cámara y los lentes, lentes desmontables, enfoque de control remoto, montura para el portaranuras, montaje para el lente de campo y visor. Como accesorios que ayudan a obtener el ajuste relativo propio entre el objeto y la imagen final, tiene un proyector de ranura iluminada, un montaje de precisión para el lente corrector de astigmatismo y un visor de imagen panorámica. Para proteger al personal en la eventualidad de que ocurra una explosión del espejo mientras está en funcionamiento la cámera, se le ha dotado de brindaje. Este trabajo ha sido ejecutado bajo los auspicios de la Comisión de Energía Atómica de E.U.

Digitalrechner für automatische Fernseh-Schaltungskontrolle

A. B. Ettlinger [145]

Das erste Ausführungsbeispiel von einem Digitalrechner für automatische Fernseh-Schaltungskontrolle ist durch Columbia Broadcasting System entwickelt worden und ist seit dem 31. Dezember 1960 im Betrieb. Das entstehende System bringt eine erhebliche Erhöhung über vorhergebrauchte Arbeitsverfahren in Hinsicht auf betriebliche Absorbierbarkeit, Durchsichtbarkeit der Programm Aufstellung, und Verwendbarkeit zu Änderungen in der Betriebspraxis. In Begegnung dieser strengen Anforderungen zeigt sich der Digitalrechner ökonomisch fehlerfrei zu sein, mit der Darbietung von Besonderheiten unerreichbar durch andere Mitteln, mit Ausnahme von Solchen die untragbare Kosten mitbringen. Dieser Bericht beschreibt die theoretischen Betrachtungen sachdienlich dieser Ansuchung. (*Ub. von W. G. Connolly*)

Automatisches Sequenzschaltgerät für Fernsehbetrieb

F. Cecil Grace und Charles E. Spicer [150]

Es wurde eine automatische Schalteinrichtung für Fernsehbetrieb entworfen, die dadurch gekennzeichnet ist, dass Ereignisse und die zum Senden derselben bestimmten Zeitabschnitte in Gedächtniselementen mit strahldrehenden Trochotronröhren aufgespeichert werden. Sobald Sendung eines Ereignisses beginnt fängt auch das Zählen an: 10–9–8–7 usw. bis herunter zu null. Sobald der Nullpunkt erreicht ist wird automatisch das nächste Ereignis gesendet und das Zählen der ihm zugewiesenen Zeit beginnt von neuem. Falls der Programmleiter eine gerade laufende Programmnummer abschalten will bevor deren Zeit abgelaufen ist, drückt er einen "Umschalt"-Knopf seines Schaltbrettes und sofort beginnt die Sendung des nächstfolgenden Ereignisses. In ähnlicher Weise kann er die ursprünglich zugewiesene Zeit eines gerade im Sendeapparat laufenden Ereignisses verlängern, indem er einen "Warte"-Knopf drückt; dadurch wird das Zählen aufgehalten und die Sendung läuft weiter bis der Programmleiter bereit ist das nächste Ereignis zu senden, was dadurch geschieht, dass er den "Umschalt"-Knopf niederdrückt. Das Gerät erlaubt daher eine ganz genaue automatische Zeiteinteilung und gibt doch die Möglichkeit dieselbe von Hand aus nach Belieben zu ändern.

Normwandler für den Programmaustausch zwischen Europa und Nordamerika

A. V. Lord [156]

Mit der Einführung der FS-Bildaufzeichnung auf 2-Zoll Magnetband durch die Rundfunkanstalten und Sendegesellschaften beiderseits des Atlantiks ist ein wesentlicher Beitrag für einen allgemeinen Programmaustausch geleistet worden. Die Tatsache, dass es sich bei dieser Aufzeichnungsart um die Speicherung des Videosignals handelt und nicht wie bei der Filmaufzeichnung um eine reine Bildspeicherung, wirft weitere Probleme auf. Die verschiedenen Fernsehnormen erfordern die Umwandlung des Signals von der einen Norm auf die andere.

Eine befriedigende Lösung dieses Problems ist in Europa, wo drei Abtastnormen verwendet werden (819, 625 und 405 Zeilen), während mehrerer Jahre angewandt worden. Die gemeinsame Halbbildfrequenz von 50 Hz hat darüber hinaus zu einem verhältnismassig einfachen Verfahren der Normwandlung geführt. In mehreren Arbeiten (1–3) wurde das Problem des Normwandlers dargestellt und die hierfür geeigneten Geräte beschrieben.

Weitere Untersuchungen haben nun zur Entwicklung eines Normwandlers geführt, der auch dann verwendbar ist, wenn die Halbbildfrequenzen 50 Hz einerseits und 60 Hz andererseits betragen.

"Ungewöhnliche Filme:" Die Filmstreifen Produktion und Ausbildungs-Einheit auf der Bob Jones Universität.

Katherine Stenholm [160]

Die Einheit produziert und verteilt 16mm dramatische Spielfilme über religiöse und bildende Themen, Reisebeschreibungen, dokumentarische Lehrfilme und kurze Werbefilme. Umfassende Kurse, welche zum Range eines Baccalaureus und eines Magister der Kinematographie führen, sind angeboten. Die Studio- und Ausstattungsgelegenheiten sind

verhältnismässig einzigartig unter den höheren Bildungsanstalten. "Ungewöhnliche Filme" besorgt das "Laboratorium" für praktische Erfahrung in allen Phasen der Filme, für Studenten welche in der Abteilung von Kinematographie auf der Bob Jones Universität Schule der freien Künste, studieren. (*Üb. von Jurgen Matthia*)

Das Filmstudio der Brigham Young Universität

ROBERT W. STUM und R. IRWIN GOODMAN [165]

Im Herbst des Jahres 1958 nahm-nach fünfjähriger Forschungs- und Planungsarbeit-das neue Filmstudio der Abteilung für Filmproduktion der Brigham Young Universität seinen Betrieb auf. Der Zweck des Studios ist die Herstellung von Filmen bester Qualität und zu annehmbaren Preisen für die Universität selbst und für die Kirche Jesu Christi der Heiligen der letzten Tage (Mormonen), und es wurde so angelegt, dass eine Idee von Drehbuch bis zur Leinwand durchgeführt werden kann. Die grundlegende Einheit dieser neuen Anlage ist eine Tonfilmbühne von 24,4 × 30,5 Metern, aber es wurden auch die erforderlichen Räumlichkeiten für alle anderen Arbeiten vorgesehen, die mit der Filmproduktion in Verbindung stehen, wie für Trickbildzeichnen, künstlerisches Zeichnen, Filmarchitektur, Kulissen- und Dekorationslager, Tonaufnahme und Tonmischung. Weiters gehören getrennte Büros für Schriftsteller und Produktions-personal dazu. Die ganze Ausstattung ist modern und zweckmässig und wird den höchsten Ansprüchen gerecht.

Physikalische und technische Parameter der Blitzlichtröhren.

I. S. MARSHAK und L. I. SHCHOUKIN [169]

Es wurden Untersuchungen an Blitzlichtröhren vorgenommen und zwar an solchen mit beschränkter Entladungskolonne (Kapillarröhren) und an solchen mit unbeschränkter Entladung (Lampen mit kugelförmigen Birnen) in einem Minimalinduktanz-Schaltkreis. Die Studien erstreckten sich auch auf extreme Fälle der Konstruktions- und Speisungsparameter. Die Entladungscharakteristiken in Kapillarröhren sind ähnlich denen in Röhren grosser Durchmesser, obwohl korrespondierende Werte spezifischen Widerstandes bei elektrischen Feldern vorkommen die viel leicht 5 oder 10 mal so hoch sind.

Der spezifische Widerstand von Plasma wird fast konstant (~0,02 Ohm/cm) bei $E \geq 120$ V/cm. Die Löschspannung der Entladung ist ungefähr verkehrt proportional dem inneren Röhrendurchmesser. Die Steigerung der Beleuchtungswirkung hört bei $E \cong 400$ V/cm auf (und erreicht sehr hohe Werte von ungefähr 40 lm/w). Die Abhängigkeit der Blitzdauer τ von den Konstruktionsdaten und den Speisungsparametern wurde für eine Anzahl sehr verschiedener Umstände ermittelt. Innerhalb enger Grenzen der Änderung der Parameter kann nachstehende Formel angewendet werden:

$$\tau = AU_{\text{Null}}^{-0,5}\,(C\,l)^{p}d^{-q}$$

A ist der Proportionalitäts-Koeffizient; U_{Null} die Anfangsspannung am Speisungskondensator; C die Kapazität des Kondensators; l und d die Länge und der Innendurchmesser der Röhre, p und q ungefähr konstante Exponenten, welche sich bei grosser Änderung der Parameter von 0,5 zu 1 resp. von 0,5 zu 2 ändern. Der Einfluss der eigenen Induktanz des Entladungsschaltkreises auf die Lichtcharakteristiken röhrenförmiger Lampen ist fast ohne jede Bedeutung. Die Arbeitstemperatur röhrenförmiger Lampen aus *Quarz* und *Glas* bei langdauernder stroboskopischer Verwendung (750°C bezw. 250°C) werden bei durchschnittlichen Leistungen von ungefähr 10 bezw. 1,8 W/cm der Röhrenlänge erreicht. Die Röhren arbeiten während einiger Sekunden (ohne künstliche Kühlung) mit Leistungen von 40 bezw. 4 W/cm.

Der Belastungsfaktor $(CU^4)_{\text{max}}$, welcher die Belastungsgrenzen bei Einzelblitzfunktion bestimmt, hängt bei *Glas*röhren zwischen 0,5 und 11 mm und bei *Quarz*röhren zwischen 0,5 und 2 mm nicht vom Durchmesser d ab. Die zur Entionisierung der Gasfunkenstrecke nötige Zeit verlängert sich in kapillaren Quarzröhren, die einen Verlust von ~ 2 W/cm haben, von 80 auf 270 Mikrosekunden bei einer Steigerung des ursprünglichen elektrischen Feldes von 140 auf 280 V/cm. Bei hoher Leistung fällt die Entionisierungszeit von 500 auf 300 Mikrosekunden. Dementsprechend liegen die kritischen Blitzfrequenzen solcher Röhren (ohne ein zusätzliches Kommutationselement im Entladungskreis) bei 12 kHz bei niedrigen Wattstärken und ist ungefähr 3 kHz höher bei grösseren Wattstärken.

Zur Untersuchung von Höchstleistungen der Entladung in Röhren mit kugelförmigen Birnen wurden Versuche mit verschiedenen Kondensatoren niedriger Induktanz und mit verschiedenen Röhrenkonstruktionen unternommen. Hiezu gehörten scheibenförmige, topfförmige und zylindrische keramische Kondensatoren, zylindrische und kugelförmige Quarzkondensatoren, zylindrische Streifenkondensatoren, scheibenförmige und koaxiale Einführungen, Verbindungen und Elektroden. Das Ergebnis war die Ermittlung von Daten über Entladungsstromkreise der geringst möglichen Induktanz. Es wurden Untersuchungen der Ausbreitungsgeschwindigkeit der Entladungssäule und der Entladungscharakteristiken für verschiedene Speisungsparameter vorgenommen. Es wurden Konstruktionsdaten und Speisungsparameter für Röhren von einer Blitzdauer von 0,1 Mikrosekunde, einer Blitzfrequenz von 3 kHz und einer Stärke von 1 kW festgelegt.

Lichtquelle für Blitze von unter einer Mikrosekunde

HAROLD E. EDGERTON, JOHN TREDWELL und KENNETH W. COOPER, JR. [177]

Es werden Einzelheiten zweier Apparate für Lichtblitze von unter einer Mikrosekunde gegeben, die zum Photographieren bei reflektiertem Licht sowie für Schatten-und Schlierenverfahren in Frage kommen. Für reflektiertes Licht wurde ein "geführter" Luftfunke von 18 kV mit 0,05 Mikrofarad benützt, um einen Blitz von $\frac{1}{2}$ Mikrosekunde und einer Spitzen-Lichtstärke von 5 Millionen Kerzen zu erzielen. Es wird die Blitzröhre, die von besonderer Ausführung ist, beschrieben ebenso wie ihre Stromversorgung und der auslösende Stromkreis. Letzterer kann sowohl durch ein Mikrophon wie auch durch Photoröhre, Schaltschütz oder ein anderes elektrisches Zeichen angeregt werden und enthält eine einstellbare Verzögerung. Es werden Aufnahmen gezeigt, die mit dem Apparat gemacht wurden.

Es wird eine kleine Einrichtung beschrieben, welche instande ist, Funken von einer Dauer von ungefähr 10 Millimikrosekunden für Schatten- und Schlierenphotographie zu liefern. Die relative Lichtleistung sowie die Blitzdauer werden als abhängig vom Druck von Luft, Stickstoff, Sauerstoff, Kohlensäure, Wasserstoff und Argon angeführt. Der Spaltwiderstand ist für Luft und mit der Spaltlänge als variablen angegeben.

Die verbesserte 1 : 10 Schlitzkamera: ein vielseitiges Modell für Explosionsforschung

BERLYN BRIXNER [180]

Die früher beschriebene 1 : 10 Schlitzkamera wurde mit einer Anzahl verfeinerter Zubehörteile versehen um sie für verschiedene Probleme der Explosionsforschung zu adaptieren. Für den Gebrauch der Kamera mit verschiedenen Objektiven sind folgende einstellbare Zubehörteile vorgesehen: Kamera- and Linsenfassungen, auswechselbare Linsen, eine ferngesteuerte Einstellung, Schlitzhalter- und Feldlinsenfassungen, und Sucher. Zubehörteile für richtige relative Einstellung zwischen dem Objekt und dem Endbild sind ein Projektor für den beleuchteten Schlitz, eine feinmechanische Fassung für die Astigmatismus-Ausgleichslinse, und ein Streifenbildsucher. Aus Sicherheitsgründen, im Falle einer Drehspiegelexplosion, wurde eine Panzerplatte eingesetzt.

Ed. Note: Since last January we are publishing in the *Journal* as a regular feature translations of the titles and abstracts of all papers in French, German and Spanish. This is intended to increase the *Journal's* usefulness to the Society's growing number of non-English speaking members and subscribers overseas. Comments of readers are invited. The Society is particularly anxious that the translations used should be of the best quality obtainable, therefore comments on their quality and suggestions for their improvement would be especially welcome. Also, since the cost of buying all the translations from a commercial translator is prohibitive, any assistance that may be volunteered in obtaining translations for the *Journal* will constitute a very considerable contribution to the Society. Contributors will of course, be given full acknowledgment in the *Journal*.

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Inter-Society Color Council, 30th Annual Meeting, Apr. 10–12, Sheraton Hotel, Rochester, N.Y.

ISA, 7th National Symposium on Instrument Methods of Analysis, Apr. 17–19, Shamrock-Hilton Hotel, Houston, Texas.

DAVI, Apr. 24–28, Deauville Hotel, Miami Beach, Fla.

Electrochemical Society, Symposium, Apr. 30–May 4, Claypool Hotel, Indianapolis, Ind.

ISA, 7th National Aero-Space Instrumentation Symposium, May 1–4, Fort Worth, Tex.

AICE, National Meeting, May 7–10, Sheraton-Cleveland Hotel, Cleveland, Ohio.

89th Semiannual Convention of the SMPTE, May 7–12, King Edward Sheraton, Toronto.

SPSE, Annual Conference, May 8–12, Arlington Hotel, Binghamton, N.Y.

AIEE, IRE, Association for Computing Machinery, Western Joint Computer Conference, May 9–11, Ambassador Hotel, Los Angeles.

IRE Professional Group on Microwave Theory and Techniques, National Symposium May 15–17, Sheraton-Park Hotel, Washington, D.C.

AIEE, ARS, IAS, IRE, ISA, National Telemetering Conference, May 22–24, Sheraton Towers Hotel, Chicago.

ASME, Semiannual Meeting, June 11, Los Angeles.

AIEE, Summer General Meeting, June 18–23, Ithaca, N.Y.

AIChE, AIEE, ASME, IRE, ISA, Joint Automatic Control Conference, June 28–30, Univ. of Colorado, Boulder, Colo.

IFME, JECMB, IRE-PGBME, 4th International Conference on Medical Electronics and 14th Conference on Electronic Techniques in Medicine and Biology, July 9–14, Waldorf-Astoria Hotel, New York.

NAVA, Annual Convention, July 22–25, Hotel Morrison, Chicago.

American Rocket Society, Guidance and Control Conference, Aug. 7–9, Stanford Univ., Stanford, Calif.

SPIE, National Convention, Aug. 7–10, Ambassador Hotel, Los Angeles.

Western Electronic Show and Convention, Aug. 22–25, San Francisco.

American Chemical Society, 6th International Conference on Coordination Chemistry, Aug. 27–Sept. 1, Wayne State Univ., Detroit, Mich.

UFPA, Annual Meeting, August 1961, Berkeley Campus, U. of California.

PGIT, International Symposium on Transmission and Processing of Information, Sept. 6–8, MIT, Cambridge, Mass.

AIEE, ISA, IRE, Joint Nuclear Instrumentation Symposium, Sept. 6–8, North Carolina State College, Raleigh, N.C.

Standards Engineers Society, Annual Meeting, Sept. 18–20, Hotel Sherman, Chicago.

IRE, AIEE, Industrial Electronics Symposium, Sept. 20–21, Boston, Mass.

Illuminating Engineering Society, National Technical Conference, Sept. 24–29, Chase-Park Plaza Hotel, St. Louis, Mo.

Electrochemical Society, Fall Meeting, Oct. 1–5, Statler Hotel, Detroit, Mich.

IRE, Canadian Electronic Conference, Oct. 2–4, Automotive Bldg., Exhibition Park, Toronto, Ont.

90th Semiannual Convention of the SMPTE, Oct. 2–6, Lake Placid, N.Y.

National Electronics Conference, Oct. 9–11, International Amphitheatre, Chicago.

American Standards Association, National Conference, Oct. 10–12, Rice Hotel, Houston, Texas.

Society of Reproduction Engineers, Visual Communications Congress, Dec. 1–4, Hotel Biltmore, Los Angeles.

91st Semiannual Convention of the SMPTE, Apr. 30–May 4, 1962, Ambassador Hotel, Los Angeles.

92nd Semiannual Convention of the SMPTE, Oct. 22–26, 1962, Drake Hotel, Chicago.

93rd Semiannual Convention of the SMPTE, Apr. 22–26, 1963, Traymore Hotel, Atlantic City, N.J.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters and of the Committee Chairmen and Members were published in the April 1960 Journal Part II.

sustaining members

of the Society of Motion Picture and Television Engineers

The objectives of the Society are:

- Advance in the theory and practice of engineering in motion pictures, television and the allied arts and sciences;
- Standardization of equipment and practices employed therein;
- Maintenance of high professional standing among its members;
- Guidance of students and the attainment of high standards of education;
- Dissemination of scientific knowledge by publication.

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